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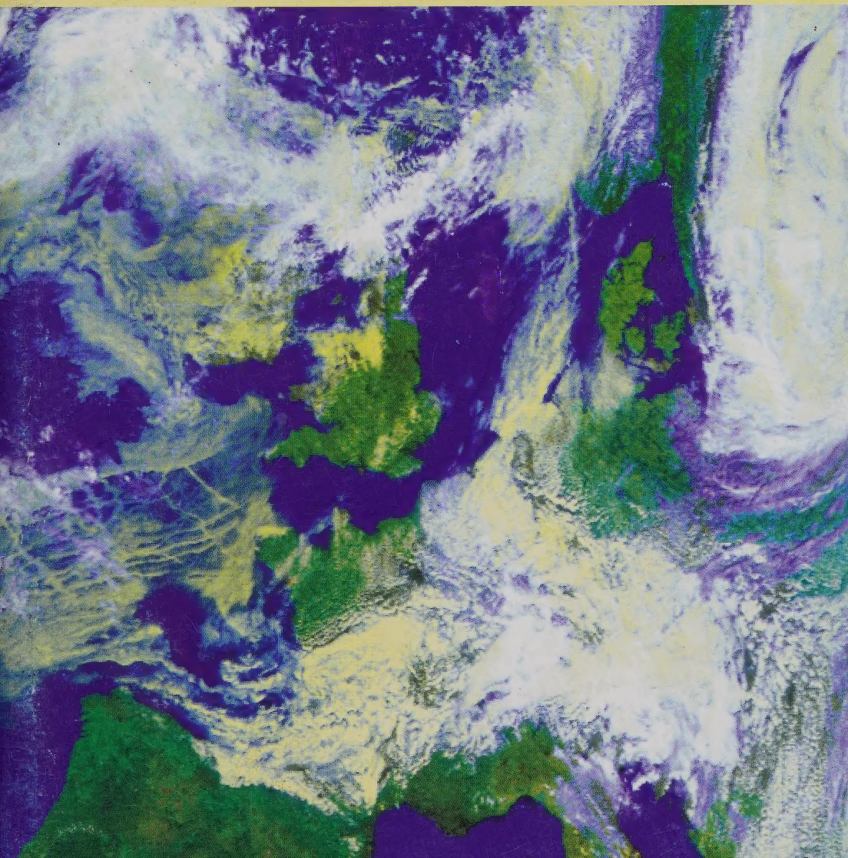

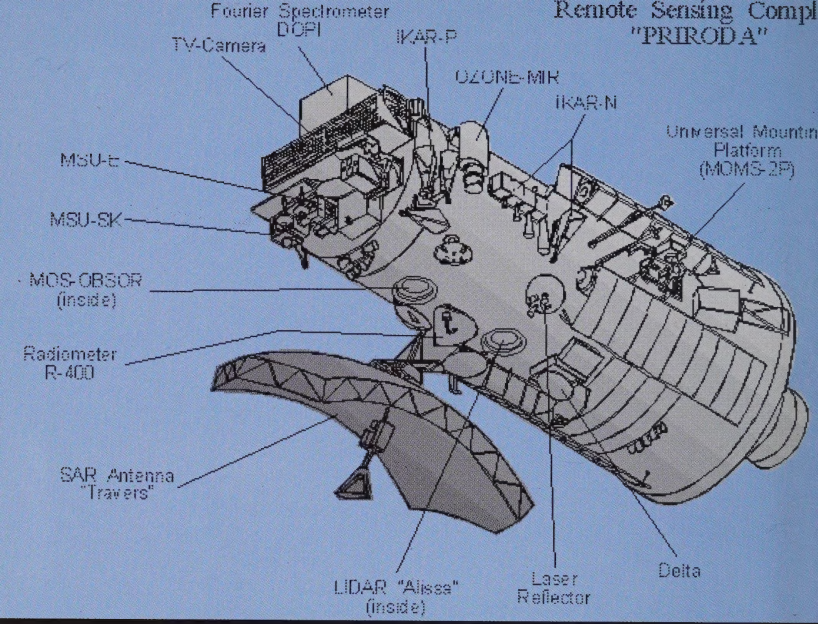
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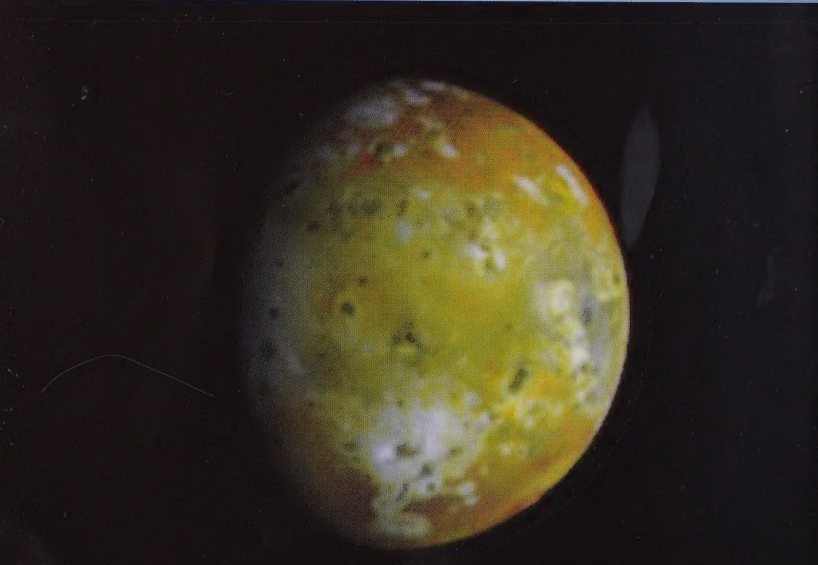

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CHAIRMAN'S REPORT

FRANK BELL

You will recall that the last journal, RIG 45, contained two inserts. One of the items reflected the committee's concern about the position of our Treasurer, Mark Clarke; because of his own work commitments he is unable to continue without assistance. I must say that the response from members for help has been disappointing with nobody apparently willing to take over the job of treasurer. Accordingly, your committee have resolved the problem by appointing a commercial firm, Tradewait Ltd to look after our accounts and VAT, but of course we will be paying them to do this work. The good news is Mark still remains our Treasurer and will continue to advise us about financial matters.

There has been some progress with the request for help with rallies but is has not been finally resolved and we are still looking for further help.

The response to the BNSC Supplement about the Millennium Satellite has been good with many members sending the reply slip to register. The data-base will be used to keep you in touch with developments and in due course provide a mailing list for materials connected with the programme. If you have not yet registered there is still time to do so; just send the reply slip to the given address. There has still been no firm promise of money from the Millennium Commission but there is to be a meeting on 18 September 1996 when the Commission will make their final decision. I am confident that the money for this project will be forthcoming.

A most important issue which is occupying the committee at the moment is that of radio spectrum management. We all know of the problems which exist in the UK from pagers on the 137MHz band and it's unlikely that the problem will go away but probably get worse. The Government have recently published a White Paper "Spectrum Management Into the 21st Century" and in this they announced a consultation programme with meetings around the country. Some of the meetings have already taken place but RIG will be represented in the next series. Just to illustrate how important it is that the views of RIG members are expressed and how serious the threat is I will quote a sentence from the RA's letter to RIG. "The White Paper announced the Government's intention to bring forward legislation to allow fees for the use of the radio spectrum to reflect its value more closely, instead of being linked to the cost of spectrum management". My interpretation of this is the Government is privatising the radio spectrum and the interests of amateur users are in great danger of being disregarded if some other commercial users can buy a slice of the action. It is a matter for concern and RIG's committee will continue to represent members interests to the Government, RA and others, in every way we can.

THE 4TH POLAR ORBITING ENVIRONMENTAL SATELLITE DIRECT BROADCAST USERS SYMPOSIUM Annapolis, MD June 10-12, 1996

John DuBois, Ed Murashie, Steve Padar

This is a report on the 4th POES symposium which was recently held in Annapolis, MD, USA. The last such symposium was held in 1988. The principal theme of this symposium was "To inform users of current and future plans of US and international polar satellite systems". A secondary theme was "... direct broadcast systems: users, applications and information sources." The attendees included scientists from the US government, military, academic and commercial community. There were representatives from foreign governmental, satellite and meteorological services. Also present were a few amateurs and 20 vendors exhibiting products and services. The symposium covered 3 days and consisted of formal lectures followed by a question and answer period .

It is, of course, impossible to do justice to the symposium in a short report but we shall summarize the highlights divided into three sections: Status of Current Systems, Planned Changes and Vendor Exhibits.

STATUS OF CURRENT SYSTEMS

POES Program Status

Gregory Mandt, NOAA

The global polar weather satellite direct broadcast system is anchored by the NOAA (TIROS) series of satellites. The NOAA system is in good health and committed by government policy to continuity of service to direct broadcast users worldwide. The widely used Russian METEOR satellite program was not represented at the symposium. The present NOAA satellite status is:

NOAA 9 : Semi-standby
NOAA 10 : Deactivated
NOAA 11 : Standby
NOAA 12 : Normal. Primary AM satellite
NOAA 13 : Inoperational
NOAA 14 : Primary PM satellite (Backup computer, SAR and ozone monitor failed)

The present US POES (NOAA) satellite system collects imagery, measures atmospheric temperature and humidity, measures surface temperature, cloud cover, water ice boundaries, ozone concentrations, aerosol distribution, vegetation indices, and proton and electron fluxes near the earth. Data are also retransmitted via these satellites from balloons, buoys and remote automatic stations. In addition, the satellites provide search and rescue location for aeronautical and maritime emergencies.

All these data are transmitted in real time, free of charge, to anyone in the world who has the necessary receiving equipment. Currently, there are about 1000 HRPT and several thousand APT users world-wide. The two primary satellites are in complementary sun-synchronous orbits:

Satellite	Orbital Altitude	Orbital Period	Orbital Inclination
NOAA 12	833km	102 minutes	98.86 degrees
NOAA 14	870km	101 minutes	98.7 degrees

In the US the afternoon satellite is considered the primary mission with the morning satellite being the secondary mission. In much of the rest of the world the reverse is true.

Baseline instruments for this 4th generation of spacecraft are:

Advanced Very High Resolution Radiometer: 5 channel scanning radiometer with two visible and 3 IR channels.

High Resolution Infrared Sounder: Takes radiance measurements in 19 spectral bands in the IR band and one in the visible band for relatively high resolution soundings to an altitude of 40km.

The Microwave Sounding Unit: A microwave radiometer which supplements the above instrument.

Stratospheric Sounding Unit: Provides temperature measurements in the upper stratosphere.

Space Environment Monitor: Charged particle radiometer which measures the Earth's radiation belts and particle precipitation from the sun.

Solar Backscatter Ultraviolet Spectral Radiometer: Measures solar irradiance and scene radiance in the ultraviolet spectrum. From these measurement total atmospheric ozone and its vertical distribution can be calculated.

Search and Rescue Beacon Receiver: Receives distress signals at 121.5MHz, 243MHz and 406MHz and retransmits them at 1544.5Mhz.

Argos Data Collection System: Collects and relays data from buoys, weather stations and free-floating balloons.

The remainder of Mr Mandt's presentation concerned the future of the POES pro-

gram and is covered below under the "... Changes ..." section.

Defense Meteorological Satellite Program (DMSP) Program Status
Lawrence Weeks, DoD

The DMSP system consists of an early morning and a late morning satellite. The primary mission of these satellites is to provide global weather data in both the visible and IR bands. The tactical fine mode resolution is 0.6km. The Operational Line Scan System manufactured by Northrop Grumman is the primary sensor for DMSP. Of interest is the ability for low-light imaging in these satellites allowing for viewing of city lights at night.

Several Special Sensor Microwave (SSM) instruments provide atmospheric and ground moisture data. These are microwave radiometers operating between 19GHz and 85GHz which pioneered the technique and have led directly to the advanced AMSU instruments which will be flown on future NOAA and METOP satellites.

The DMSP program is in good health with 7 more satellites in storage or under construction as part of original planning extending through 2009. Since the DMSP program will be merged with the NOAA program, creating a "converged" system in the early 2000s, some of the later satellites in the DMSP series may be modified to take part in the NPOES program.

Even though real time DMSP direct broadcasts are encrypted military transmissions, the imagery and SSM sounding products are widely available for research and study over the Internet and a net search on the keyword "DMSP" will yield many of the URLs.

NOAA POES Direct Readout Services/Documentation
Dane Clark, NOAA/NESDIS

NOAA's National Environmental, Satellite Data and Information Service (NOAA/NESDIS) is the manager and major data distribution center for the US POES program. They are committed to a continuity of data access through direct broadcast, publishing and Internet distribution. A main point of contact for these services is the NESDIS on-line bulletin board on the World Wide Web (WWW). From here, data and products can be obtained and specialists contacted. The NESDIS home page URL is: http://ns.noaa.gov/NESDIS/NESDIS_Home.html .

CHANGES TO BE EXPECTED IN POLAR DIRECT BROADCAST SERVICES

Speakers at the POES symposium reviewed plans of both NOAA and EUMETSAT for making changes in the direct readout broadcasts of polar orbit weather satellites

over the next 10 to 15 years. Providing this information was a major purpose of the symposium since relatively major changes are planned by all the countries which launch weather satellites. NOAA and EUMETSAT plans were explained at some length, China presented a little basic information and Russia only summarized existing programs.

The most important and far reaching change planned for both NOAA and EUMETSAT polar weather satellites is to phase out and eventually discontinue APT broadcasts completely. This will happen in stages, first on the EUMETSAT METOP satellites to be launched starting in 2001 and then on the NOAA NPOES series starting about 2006. (The latter will be the replacements for the NOAA TIROS satellites we have now.) In addition, future Chinese satellites have no plans to provide APT. No information was available at the conference on the future of the Russian METEOR program, so it may be that APT will survive on these satellites through the next decade.

The second most significant upcoming change is that starting with the next NOAA satellite (NOAA-K), which is planned for launch sometime in 1997, the 3.7 micrometer mid-infrared channel 3 will be time-shared with a 1.6 micrometer near-infrared sensor. The shorter wavelength sensor will be switched into channel 3 during daylight hours for better discrimination of smoke and ash plumes. It is not expected to impact APT users who normally see only the 10 micrometer thermal infrared sensor. The principal impact of this change for HRPT users will be poorer daylight discrimination of fires which stand out clearly at 3.7 micrometers.

Of interest to HRPT users, NOAA will significantly improve the microwave sounder instrument, starting on NOAA-K. Data from this instrument appear in the "TIP" header block and are not currently extracted by most entry level HRPT software. However, several papers were presented showing how useful these channels are in detecting snow, ice and ground moisture even though the spatial resolution is only 15 to 90km. It should not be much trouble for current vendors of entry level HRPT systems to include a simplified form of this data in their software packages.

The plans for "convergence" of the NOAA and DMSP programs were presented. It appears that there is still a lot of room for change in what will happen here, especially with regard to the schedule, but the basic idea is that the satellites already built or paid for (7 more DMSP and 5 more NOAA) will be launched through about 2005. Then the NPOES program satellites will take over the job done by both. NPOES will have advanced instrument capabilities and still have freely available direct broadcast services BUT the direct broadcast will include a "denial" option so that the US government can encrypt those signals "in times of crisis".

The replacement for APT will be LRPT - Low Resolution (Digital) Picture Transmis-

sion. It is almost certain that the specifications and format for LRPT will be common between NOAA and EUMETSAT although this has yet to be fully worked out. An excellent reference on characteristics of the LRPT format can be found in RIG issue number 45, June 1996.

POES Program Status
Gregory Mandt, NOAA

The next satellite is NOAA-K which will become NOAA 15 when launched sometime in 1997. This begins a series extending through NOAA-N' which will have new microwave sounding instruments (AMSU-A and AMSU-B) and improved versions of the visible/infrared imager/radiometer (AVHRR/3) and infrared sounder (HIRS/3). The primary improvements in the microwave instruments will be greater temperature resolution through more RF channels. The main change to the AVHRR is a sixth infrared channel at 1.6 microns for improved snow/cloud discrimination. This will be called channel 3A and will be broadcast (HRPT) during daylight hours. The current channel 3, at 3.7 microns will be called 3B and broadcast during night. In the longer term, the NOAA series satellites will be coordinated with the EUMETSAT METOP polar orbiters, starting about 2001, with METOP as the morning satellites and NOAA as the afternoon. These instruments will be essentially like those of the NOAA K through N' series. In the even longer term, the US contribution to the polar constellation will be the NPOES satellites with merged TIROS and DMSP capabilities. These specific instrument capabilities are in the "concept phase" and not yet decided.

NPOES Program Status
James T. Mannen, NOAA

The NPOES program is the "converged" system to replace both the current NOAA/TIROS and the DMSP polar satellites. Convergence was mandated by a US Executive order in May 1994. Since that time an Integrated Program Office has been set up and has studied requirements and possibilities for a converged system. The resulting system is expected to come on line about 2006 and consist of 2 operational satellites at any time, like the present NOAA system. Specific instrument capabilities have not yet been specified but can be reasonably guessed as similar to NOAA-N'.

EOS Program Status
Robert Price, NASA

The NASA/NOAA Earth Observation System (EOS) is a very large, multi-mission, multi-vehicle program which is part of the US "Mission to Planet Earth" for global climate change study and other scientific purposes. It incorporates programs from

almost all US satellites (including, for instance, LANDSAT) and includes cooperative use of many international Earth observation satellites. Although, technically, EOS includes the NOAA, METEOSAT, METEOR and GOES systems we use every day, most of the program satellites are not intended for direct broadcast service (DBS). A few new ones, however, will include some DBS capability. The majority of the new programs are not relevant to even the advanced RIG user but one, AM-1, holds out an intriguing possibility. It will be a 98 degree polar satellite at 705km altitude. Its imager will be multispectral with 10ft (3m) resolution and will broadcast between 8025 and 8400MHz at a 13Mbps data rate. Reception should be possible on a tracking 10ft (3m) dish. This is far more suitable for "amateur" reception than LANDSAT or SPOT which have data rates up around 90Mbps. AM-1 is scheduled for launch in 1998 and its follow on, AM-2, around 2004. Here, then, is a fascinating challenge for our members who have had nothing to work on since HRPT, PDUS and GVAR! An initial point of contact for AM-1 information will be found on the World Wide Web at http://sdcd.gsfc.nasa.gov/ISTO.

METOP Program Status
Michel Langevin, EUMETSAT

METOP will be the EUMETSAT portion of the cooperative international polar orbit weather satellite constellation over the next decade. METOP is committed to DBS capability with observing instruments similar to NOAA K through N'. The first launch is scheduled for 2002. It is planned that METOP will take over the local morning orbits. Complete data will be broadcast in the HRPT format, compatible with current frequencies and standards. As in the NOAA series, a major objective of the advanced instrument suite will be to develop high quality vertical temperature profiles for use in initializing the various numerical weather prediction models. This will be accomplished with the Advanced Microwave Sounder (AMSU) and High Resolution Infrared Sounder (HIRS).

For DBS users receiving APT with basic ground stations, however, the biggest impact of METOP will be the move to LRPT ... APT will be dropped entirely. The transition will be a little less abrupt since the NOAA series will carry APT until about 2006, but eventually APT will be no more!

Introduction to Chinese Polar-orbiting Meteorological Satellites
Fang Zongyi, National Satellite Meteorological Centre

China has significant plans for meteorological satellites over the next decade in both polar and geostationary systems. The Feng Yun polar program will continue with another launch, FY-1C, planned for the 1997-8 period and FY-1D in 1999. The main HRPT broadcast frequencies were reported to be planned on 1700.5MHz or 1704.5MHz, which avoids the NOAA HRPT backup frequency at 1707MHz. (A

1708.5MHz frequency was also given, but only for data broadcast over China.) The data format for these broadcasts is CHRPT which will carry more data than HRPT which was used on FY-1A and B. CHRPT will be similar to HRPT, but at a 1.3308Mbps rate which is twice that of HRPT. The image portion of the format will carry 10 channels, 5 in visible wavelengths and 5 in IR. As with the earlier Feng Yun instruments, the multiple visible wavelengths will allow "full" color composites to be made and should produce some stunning imagery. The CHRPT format and higher bit rate, however, will require changes to hardware and software. Now seems to be the time to start lobbying the vendors for this capability!

Changes to the NOAA K and Direct Readout Service
Thomas Wrublewski, NOAA

NOAA K through N' (15-19) will carry a substantially improved passive microwave radiometer, called AMSU, as a moisture sounding instrument. Less elaborate microwave radiometers have been flown on NOAA and DMSP satellites since 1978 and have proved their utility for water/moisture measurements both in clouds and on the ground. The AMSU will carry 20 measuring channels between 19GHz and 90Ghz with resolution ranging from 55km to 15km. These data will be broadcast in the HRPT TIP header frames.

The AVHRR instrument will incorporate a sixth infrared channel at 1.6 microns for improved snow/cloud discrimination. This will be called channel 3A and will be broadcast (HRPT) during daylight hours. The current channel 3, at 3.7 microns will be called 3B and broadcast during night. The albedo response curves of channels 1, 2 and 3A will be changed to improve low light contrast by use of a dual slope function. The range between 0% and 25% albedo will be represented by a linear change in output counts between 0 and 500. The remainder of the range from 25% to 100% albedo will produce a linear count from 500 to 1000.

Direct Readout Frequency Issues
David McGinnis, NOAA

Use of the meteorological satellite DBS bands at 137-8MHz and 1675-1710MHz is no longer confined to metsats. As a result of new allocations made during the 1992 WARC Conference, the lower band, particularly, is coming under pressure from the new Mobile Satellite Service (MSS), the Direct Sounder Broadcast (DSB) and, in the UK, paging services. The MSS also has shared allocations now in the high band. Now, only segments of the APT band have protection for meteorological services as primary users. These segments are 137.025-137.175MHz and 137.825-138.000MHz. The latter, however, is not protected from pagers in the UK. APT, and ultimately LRPT, broadcasts therefore, are potentially subject to interference as a result of the complex overlapping of usage rights of various countries. This situation is far from

resolved, it is really only beginning to be defined.

Potential AMSU Surface Applications
Norman Grody, NOAA

Potential AMSU Precipitation Applications
Ralph Ferraro, NOAA

The AMSU instruments which will be flown on virtually all new meteorological satellites, starting with NOAA-K will provide operational moisture data, both in clouds and on the ground at resolutions between 15 and 55km. The AMSU will replace the older, essentially experimental, MSU and DMSP SSM instruments. The primary application of these data will be in numerical weather forecast modeling and improved snow and ice cover reporting. These data have not been previously used by the amateur community but deserve consideration since they can produce useful ice and snow cover information in areas covered by cloud.

Developing a Strategy for LRPT
James Silva, NOAA

The current APT direct broadcast of weather imagery in the 137-138MHz VHF band is an old system dating back to the 1960s. This service currently provides many thousands of users worldwide with real-time views of local weather conditions at very low cost. Many pressures, however, have led to the planning, design and implementation of a new format of VHF meteorological direct broadcast which will eventually replace APT completely. The new LRPT format will deliver more data at higher quality to the same user community. Ground station cost will no doubt be higher until economy of scale begins to affect equipment production, but the LRPT system design has been done with cost containment as an important parameter. Requirements for the VHF "front end" or RF system of LRPT will be unchanged from APT. The antenna and RF stage of receivers will have specifications/requirements identical to those for APT. However, receiver IF stages, demodulator and data processing requirements will be entirely new. The essential parameters are bandwidth: 150kHz, modulation: differential QPSK, coding: concatenated (Viterbi or Reed-Shannon), data format: packetized and image compression: JPEG. Although unfamiliar to many DBS users, these techniques lend themselves well to digital VLSI chip designs and fast PC/software methods. The good news is that both EUMETSAT and NOAA are committed to providing prototype hardware and software designs well in advance of LRPT implementation to provide a basis for both commercial and amateur equipment. Initially, LRPT broadcast has been planned at 137.1MHz and 137.9125MHz. The latter channel, however, is susceptible to interference from pagers and METEOR and may be dropped.

SUMMARY OF VENDOR PRODUCTS AND SERVICES PRESENTED

A cross section of the satellite industry was represented by twenty vendors. Included were aerospace companies, hardware/software ground equipment vendors, data providers, governmental agencies and an educational institute.

AEROSPACE COMPANIES:

Aerojet, ITT Industries, Northrop Grumann and TRW participated at the show. Unfortunately, none of them brought a satellite to look at, only pictures, brochures and videos. Northrop Grumann, however, brought a prototype of a linescan sensor. Aerojet manufactures several of the sounders for the TIROS and DMSP satellites. ITT manufactures the AVHRR scanner and the high resolution infrared radiation sounder for the TIROS satellite while Northrop Grumman manufactures the operational line scanner system for the DMSP satellite, which is the counterpart to the AVHRR scanner on the TIROS. TRW is the company who puts all the parts together and creates satellites like TDRSS, DSP, and Odyssey. They also develop sensors, antennas and propulsion systems.

HARDWARE/SOFTWARE GROUND EQUIPMENT VENDORS:

Hardware/software vendors included Analytical Graphics, General Sciences Corporation, Harris, Northern Video Graphics, Quorum Communications, Smartech, Systems West, Tecnavia and Timestep.

We all have seen tracking programs but not tracking programs like satellite Tool Kit V3.0 from Analytical Graphics. Analytical Graphics had a workstation running their newest software at the show. Running under UNIX, Windows 95 or Windows NT, many complex relationships in space can be visualized such as generating the look angle between two satellites or the effect of sun azimuth and elevation on a scene.

General Sciences handed out brochures and answered questions about their Metpro and PC Metpro workstations. The Metpro is a meteorological SGI based workstation that displays and analyzes satellite, radar, surface and air data. The Metpro can also format the data to be downloaded and analyzed in less demanding applications on the PC Metpro.

Harris had their SWIFT Meteorological Satellite Small Weather Information Terminal on hand. It is a two-man (for instance, Marines) portable system consisting of a 3ft (90cm) HRPT tracking dish, receiver and SPARC 5 workstation. Options were available for high and low resolution TIROS, DMSP, GOES and Meteosat. If you are going to take over a country, take a look at this system.

Russ Green was watching over the Northern Video Graphics. We felt sorry for Russ and the Beanlands. They had the locations next to each other near a large window and we had never seen so many home brew sun shields to keep the sun's glare off computer screens. However, there was good reason to put up with the sun and see the software displayed here! Russ's Polarview software is a subset of the Megaview package for the PC. Polarview does scheduling, image calibration, mapping, gridding and has interfaces to the Quorum hardware for APT imagery. Megaview adds the feature set for WEFAX display and processing. Besides good software, Russ has APT/WEFAX hardware to back it up. From antennas to PC plug-in receiver/demodulators to parallel port acquisition units. Pricing ranges from $450 for a plug-in APT receiver to $3200 for the parallel port receiver/acquisition unit.

Allan Bundens was on hand from Quorum to answer questions and show off their hardware. They pretty much had one of everything they offer at the show. There was a QF-137 quadrifilar and 4ft (1.2m) HRPT dish. In receivers they had the new standalone Wefax Voyager and the PC plug-in Wefax Explorer. The Voyager is connected via serial port to a PC, making it ideal for laptop applications. Both units use the QFAX PC software to capture, display and process the images. Their HRPT hardware included an integrated feed/downconverter, PC plug-in receiver and bit/frame sync board. A complete system runs for $15K and all pieces can be individually purchased. Quorum also showed off components of their new GVAR data server, including the PC plug-in BPSK receiver and digital bit/frame formatter. They are deciding if they will sell the GVAR unit to amateurs.

Smartech's HRPT antenna caught our eye. It consisted of a small rotor and electronics mounted on a plate 18 inches (45cm) in diameter. Mounted on the rotor was a one inch (25mm) thick, 18 inch (45cm) diameter, flat antenna, consisting of an array of patch elements. The whole unit fits inside a dome for environmental protection. Smartech sells HRPT and GVAR PC base receiving, displaying and image processing systems. They have three models for researchers through educators. The system consists of an antenna with integrated feed/downconverter, a Pentium PC running Windows NT, a plug-in receiver and a bit/frame synchronizer.

System West had a slide show of their three acquisition/server systems; the 2070 APT/WEFAX, the 6000 HRPT and the 5350 geostationary high resolution acquisition system. All three systems are PC networked units. The APT/WEFAX unit could display and process the data. The other two systems were capture-only engines and were networked to display/processing workstations. All units had external receivers and internal demodulation cards. They did not have any actual hardware or pricing at the booth.

Tecnavia's product line includes three PC-based acquisition, display and processing systems; the Skyceiver PC SDUS system, the Skyceiver Win PDUS system and the

Skyceiver Win-HRPT system. All used external rackmounted receivers and bit synchronizers. Fully self-contained intelligent demodulator and frame synchronizer PC plug-in boards capture and store the data. All the data are then later downloaded to the hard drive. This allows data to be received while processing other images. Also SDUS, PDUS and HRPT boards can be plugged into the same chassis for flexibility.

Timestep equipment was well covered. Dave Cawley was at the Timestep booth and John and Dorothy Beanland were at the Spectrum International booth. Spectrum International is the US Timestep representative/distributor. The Timestep booth had a PC and large monitor displaying the new PROsat software. PROsat is the capture, display and image processing Windows program for APT and WEFAX. Precaptured images were displayed and gridded, geolocated, animated, false colored in multiple image windows. The Spectrum International booth displayed all the Timestep hardware needed to capture HRPT images. An interesting new piece of hardware was the 4ft (1.2m) dish with helical feed. Going price was $3600 for an amateur setup and $5200 for the professional setup with a heavy duty antenna rotor.

DATA PROVIDERS:

Two data providers were present; Service Argos and the Royal Netherlands Meteorological Institute.

Ever had spare time and wanted to track a moose? Well you can start by getting in touch with Service Argos. Service Argos provides data telemetry channels for things like ocean buoys and wild animal tracking collars via the weather satellites. They were at the show trying to track down customers and answer questions about their service.

Royal Netherlands Meteorological Institute was on hand to talk about how they can provide real-time delivery of polar stereographic AVHRR imagery. One of the interesting products is suspended matter concentration images of the North Sea. The image is produced by using channel 1 AVHRR data calibrated with measured data from the "MS HOLLAND" sailing along the Dutch coast.

GOVERNMENTAL INSTITUTES:

The National Aeronautics and Space Administration (NASA) and the National Climatic Data Center (NCDC) were the two governmental institutes at the show.

NASA's contribution to understanding global change is the Mission to Planet Earth (MTPE) program. The Earth Observing System (EOS) is one part of the MTPE pro-

gram and the Earth Observing System Data Information System (EOSDIS) is the system used to distribute the DATA from satellites to the researchers. After the guy in the booth explained all the acronyms, he explained how one could obtain free access to the same data via the Internet. Images including SAR, AVHRR, water vapor, ozone and many more can be found through links at http://eos.nasa.gov/imswelcome, http://epserver.gsfc.nasa.gov/earth/earth.html and http://eos.nasa.gov/v0ims.

The National Climatic Data Center (NCDC) is a Government clearing house of global surface, upper air and satellite data. They can be reached on the Internet at http://www.ncdc.noaa.gov. An excellent NCDC server is the Satellite Active Archive (SAA) server at http://www.saa.noaa.gov/ which allows searching for AVHRR imagery by date, sensor, platform and geographic location. After previewing the image, you can order it for free and download it by ftp. DMSP, ADEOS, ERS/2, GOES and RADARSAT imagery are services expected to be provided in the future.

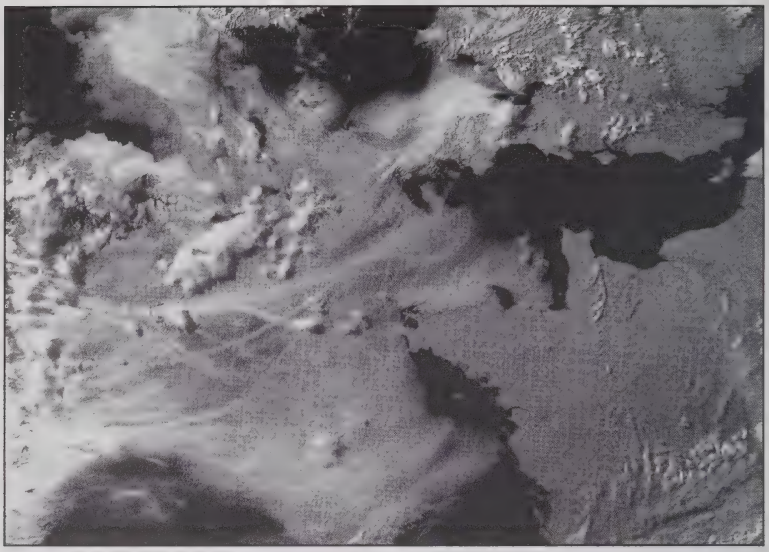
EDUCATIONAL INSTITUTE:

The one educational institute represented was the Maryland Space Grant Consortium. The consortium teaches teachers how to teach space science and math. One-week workshops prepare teachers on establishing programs at their schools and dealing with technology, budgeting and funding issues. Bob Popham (formerly at NOAA), who has worked with the satellites for over 25 years, is the lead instructor. One of the program students watched over the booth and gave part of a lecture.

SHIP TRAILS
CG Roberts

The NOAA 14 pass on 10 July 1996 at 1255UT revealed interesting features in the cloud structure to the south west of the British Isles. Long, intersecting lines were evident in the thin cloud sheet on the visible image. They were barely visible on the infrared image. Similar in appearance to aircraft exhaust condensation trails (contrails), but at near-surface temperatures, they are caused by ships.

Scorer's book "Spacious Skies" covers the subject in some detail. It seems that they are rarely seen, occurring only in tenuous, shallow cloud or sea mist capped by a stable layer as is often present in anticyclonic conditions. The exhaust from ship's funnels contains large numbers of condensation nuclei; probably in excess of 20,000 per cubic centimetre, according to Scorer. Convective processes carry these exhaust gases up into the cloud tops where the number of droplets is greatly increased. The resultant cloud thus appears much whiter than the surrounding unaffected area and shows as a trail along the ship's track. They are often hundreds of kilometres in length and can persist for many hours. The long persistence of these trails is throw-



ing new light on the processes of dispersion of pollutants in the atmosphere which is much slower than originally thought.

[Mr Roberts submitted the composite visible/infrared image which appears on the front cover. Vic Bear alerted me to this phenomenon after the NOAA 14 pass and I received this HRPT image from NOAA 12 later in the day under low illumination. I have received reports that the features were also visible on the early morning NOAA 12 pass. By chance, they also show on one of the Meteosat 5 images submitted by Marciano Righini et al elsewhere in this issue. Ed]

INTERNET NEWS

On 1 August EUMETSAT started their Internet pages, which provide general information about EUMETSAT and details of the operational activities. The address is: http://www.eumetsat.de and these pages supersede the existing electronic bulletin board.

Dartcom now have a WWW page which contains marketing information plus TBUS and 2-line elements which are updated on Sunday evenings. NEWPRED.DAT contains elements for active, or potentially active, weather satellites. Address is: http://ourworld.compuserve.com/homepages/dartcom the files are available on their BBS.

This journal includes a report on the POES symposium held in June but, for anyone wanting more information, most of the papers presented are available at the following address: http://140.90.207.25:8080/EBB/ml/nic10.html

There are some nice images, including hurricanes (some with mpeg movie loops), available from the National Climate Data Center at http://www.ncdc.noaa.gov/pub/data/images/olimages.html The image reproduced here came from this site.

Les Hamilton has found a good source of HRPT images of Alaska and adjacent areas. Try: http://www.alaska.net:80/~nwsar/html/sat/sat.html On many processed satellite images found on the Internet the whitest clouds are often 'burned out' but on the following site, also notified by Les, the images seem to be well processed and, unusually for an American site, are not cluttered up with political boundaries. Try http:// apollo.lsc.vsc.edu/gopher-data/Pictures/wxgifs.sat/q8vis.gif for visible GOES 8 images of North America.

The recent 'Life on Mars' revelation is somewhat out of RIG's activities but for anyone interested, Mike Robinson has several pointers to interesting pages on the Space Sites menu on his homepage; http://www.airtime.co.uk/users/homebase/homebase.htm

Hurricane Bertha at landfall. GEOS 8 VIS 1815 UT 12 July 1996.

A METEOSAT PDUS THE EASY WAY

Guido Emiliani, I4GU
Marciano Righini, I4MY
Giampaolo Rossini, IW4CSG

We have already proposed a Primary Data User Station in RIG Journal 33, June 1993. Now most of the HR digital images transmitted by Meteosat are encrypted - only four slots a day are unencrypted: at 00, 06, 12 and 18 GMT when one can display two or three images which, during day-time, are BIV, AIVH and BW. In spite of the shortage of pictures, we venture to describe a receiving system which is much simpler than the previous one because it does not need the Memory Buffer Unit, a subsystem that discouraged many homebrewers from building such complex hardware. In this project all the functions of the Memory Buffer are carried out by the software.

Before describing the receiving station, we will examine the coding scheme used by ESA emphasizing the relationship between the data transmitted and the functions performed by our hardware and software.

Characteristics of Digital Transmissions

Geographic formats - The A-format represents the whole Earth-disk (Fig. 1). B-format represents the northern part of the disk with Europe in the middle (Fig. 1). X-format represents the North and South American Continents (Fig. 2). *The system recognizes the format automatically when an image is received.*

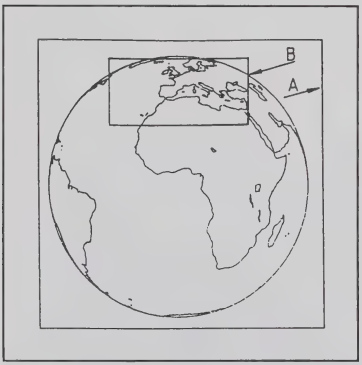


Fig 1. High-resolution formats A and B.

Fig 2. High-resolution format X.

Channels or spectral bands - The radiometer of Meteosat can explore the Earth in three channels or spectral bands: visible VIS (0.4-1.1μm), infrared IR (10.5-12.5μm), water vapour WV (5.7-7.1μm). The IR and WV images are transmitted inverted relative to WEFAX, i.e. black is cold and white is warm. *You have to chose the spectral band you want to display or store.*

Image - An image consists of a number of lines belonging to the same slot and the same spectral band. Slot means an Earth full-disk scan.

Transmission formats - A transmission can contain image data belonging to one, two or three spectral bands. The possible combinations are:

A-format	
AV	2500 lines VIS1 x 5000 pixels + 2500 lines VIS2 x 5000 pixels (23.5min)
AI	2500 lines IR x 2500 pixels (6 min)
AW	2500 lines WV x 2500 pixels (6 min)
AIV	2500 lines IR x 2500 pixels
	2500 lines VIS1 x 5000 pixels + 2500 lines VIS2 x 5000 pixels (29.3 min)
AIW	2500 lines IR x 2500 pixels
	2500 lines WV x 2500 pixels (11.8 min)
AIVW	2500 lines IR x 2500 pixels
	2500 lines VISX x 5000 pixels
	2500 lines WV x 2500 pixels (23.5 min)
AIVH	2500 lines IR x 2500 pixels
	2500 lines VISX x 2500 pixels (11.8 min)
B-format	
BV	625 lines VIS1 x 2500 pixels + 625 lines VIS2 x 2500 pixels (3.1 min)
BI	625 lines IR x 1250 pixels (0.9 min)
BW	625 lines WV x 1250 pixels (0.9 min)
BIV	625 lines IR x 1250 pixels
	625 lines VIS1 x 2500 pixels + 625 lines VIS2 x 2500 pixels (3.8 min)
BIW	625 lines IR x 1250 pixels
	625 lines WV x 1250 pixels (1.6 min)
BIVW	625 lines IR x 1250 pixels
	625 lines VISX x 2500 pixels
	625 lines WV x 1250 pixels (3.1 min)
X-format	
LXI	1250 lines IR or VIS x 1250 pixels (1.6 min)
Tests	
ATEST1	2500 lines x 2500 pixels (6 min)
ATEST2	2500 lines x 2500 pixels (6 min)

Notes

a) VIS1 and VIS2 contain the data of the two visible channel sensors. When both are used, the earth-disk is subdivided into 5000 lines and the resulting resolution is 2.5km at the subpoint.

b) VISX = VIS1 or VIS2. In formats AIVW, AIVH and BIVW the data of only one VIS sensor is transmitted.

c) VH carries only one VIS channel with data reduction (each second pixel); hence the line contains 2500 pixels instead of 5000.

d) B-format - As the scan goes from south to north, in B-format the first line number is 1810, the last is 2434. The first pixel within the line is 626, the last is 1875 in case of IR and WV information. The first pixel within VIS lines is 1252, the last is 3751.

e) X-format - LXI represents the whole earth-disk as seen by GOES-E. LXI carries only one channel which can be IR (odd slots) or VIS (even slots). IR is often encrypted, VIS is not encrypted. Dissemination takes place every three hours at 0054, 0354, 0654, 0954, 1254, 1554, 1854, 2154 GMT. *As byte 16 in the label of X-format subframes is always FF, both IR and VIS images are received by choosing the IR option in our program.*

f) Tests - ATEST1 is unencrypted and carries a grey scale with 16 sectors. ATEST2 is always encrypted. *Both tests can be received by choosing the WV option in our program.*

Construction of Frames and Subframes

Frames - The data stream is divided into blocks of words called frames. Each frame consists of 364 words of 8 bits. A frame contains a line segment. On this segment there are not only the image data, but also the data concerning synchronization, identification, label, grid, etc. Obviously these are data fields to be ignored when displaying the image.

Subframes - A set of frames forms a subframe (the terminology is misleading: a subframe is longer than a frame). A subframe contains one image line (half line in case of full-resolution VIS data). The subframes are not all the same length: B- and X-format subframes are 4 frames long and A-format subframes are 8 frames long (see Table 1).

Elements of subframes - The fields used in data subframes are:
- synchronization word
- identification word
- label
- fillers
- grid information

We will examine only the elements essential to the identification and visualization of images.

Synchronization word - It is identical in all frames. It consists of three bytes as follows: (MSB) 00000101 00001100 11011111 (LSB).

Format and frame identification word - It consists of one byte (8 bits). The 4 most significant bits identify the format (A=0111; B and X=0011). The 4 least significant bits indicate the frame number within each subframe.

When the Sync Detector (Fig. 7) recognizes the first 4 words of a subframe, it gives a pulse (subframe sync) signalling the start of a new line or half line in case of full resolution VIS images. At the same time it gives another pulse (format ID) which is high if the format is A, or low if the format is B or X. Thus the Word Strobe Detector (Fig. 8) knows which format it has to deal with.

Label - Each subframe contains a 24-word label whose contents are as follows :

Bytes	Meaning
1-2	Number of frames per subframe: 8 for A-format; 4 for B- and X-formats
3-4	Number of subframes in the transmission format
5-6	Current subframe number
7-8	Image line number. Headers = 0. First line in A- and X-formats = 1. First line in B-format = 1810
9-12	Image number from mission start
13	Format indicator: A = 00; B = FF; X = 0F (hex)
14	VIS1 indicator } 00 = data not present; F0 = 1st half line present;
	} 0F = 2nd half line present;
15	VIS2 indicator } in AIVH-format bytes 14 or 15 are set to FF
16	IR indicator 00 = data not present; FF = data present
17	WV indicator 00 = data not present; FF = data present
18	Grid indicator 00 = grid not present; 0F = grid present
19	Annotation text indicator: 00 on current operations
20	Scan direction : 00 = S-N and E-W; FF = N-S and W-E
21-24	Spare : all bytes are set to 00

Note - At the beginning of each transmission format there is a number of heading subframes and at the end there are one or two conclusion subframes which are a copy of the heading subframes. The description of the data contained in these subframes falls outside the aim of this project.

In our system the whole data flow is sent to the computer and software is charged with the task of deciding which bytes to display or store, and which to ignore. In

order to do this, the program reads the following data of the label:

Bytes 1-2 establish if the subframe consists of 4 or 8 frames.

Bytes 7-8 are set to 0 in the heading and conclusion subframes, thus the program ignores these subframes.

Byte 13 indicates which format is present in the subframe, and consequently the structure of the subframe.

Bytes 14, 15, 16, 17 indicate which spectral band is present in the subframe. If it is the channel chosen by the operator, the image is displayed or stored; otherwise the whole subframe is ignored and the program passes on to examine the next one.

Byte 18 indicates the presence of the grid. If the grid is present, the program stores it as Imagexxx.ret.

Fillers - They are used to keep subframes at a fixed structure. The fillers, all set to 00, are as follows:

SP1 and SP6 = 8 bytes
SP2 = 16 bytes
SP3 = not in use
SP4 = 1440 bytes
SP5 = 40 bytes

Grid information - It is enclosed in each data subframe. The nth bit of grid information corresponds to the nth byte of the image data of the same data subframe. The bit is set to 1 if the grid point is available.

The grid information of A-format consists of 316 bytes = 2528 bits. The first 2500 bits are

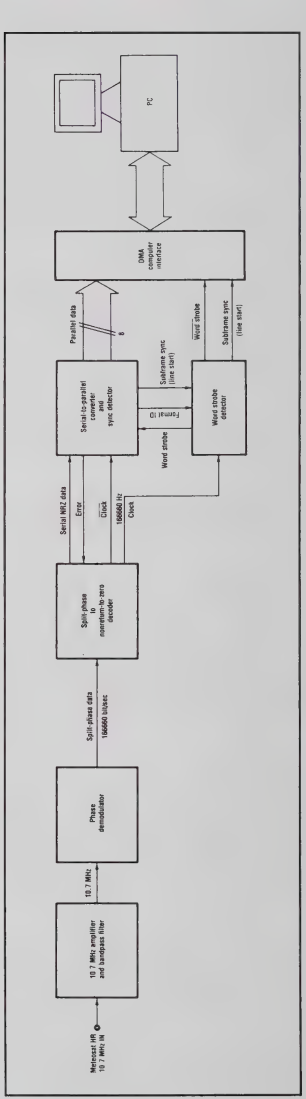


Fig 3. Block diagram of the Meteosat PDUS system.

the grid information corresponding to 2500 image pixels within the subframe. 28 spare bits are set to 0.

The grid information of B- and X-formats consists of 158 bytes = 1264 bits. The first 1250 bits are the grid information corresponding to 1250 image pixels within the subframe. 14 spare bits are set to 0.

The program can superimpose the grid on the image.

Table 1
Data subframes consist of 8 frames in A-format and 4 frames in B- and X-formats. The structure is as follows:

3 words	1 word	24 words			
Sync	Format indent.	Frame number 0000	Label	Filler: 40 words in A 8 words in B	Image data: 296 words in A 328 words in B
Sync	Format indent.	0001	Image data: 360 words		
Sync	Format indent.	0010	Image data: 360 words		
Sync word: 00000101 00001100 11011111	Most sign. 4 bits: 0111 = A format 0011 = B formats	0011	Image data 202 words in B	Further image data in A Grid: 158 words in B	
		0100	Image data: 360 words in A		
		0101	Image data: 360 words in A		
		0110	Image data: 360 words in A		
		0111	Image data 44 words in A	Grid: 316 words in A	

1 B-format subframe

1 A-format subframe

364 words

Each A-format data subframe includes 2500 bytes (words) of image information. This corresponds to 2500 image pixels and represents either one complete line of an IR or WV image, or half a line of one VIS channel image. In AIVH-format, where only each second VIS pixel is transmitted, one subframe represents one complete VIS line.

Each B-format data subframe includes 1250 bytes (words) of image information. This

corresponds to 1250 image pixels and represents either one complete line of an IR or WV image, or half a line of one VIS channel image.

Each X-format data subframe includes 1250 bytes (words) of image information. This corresponds to 1250 image pixels and represents one complete line of an IR or VIS image.

Construction of the Formats Actually Transmitted

AV-format

Heading: 42 sf = 336 fr
Data: 10000 sf = 80000 fr

VIS2	1/2 line	1
VIS2	1/2 line	1
VIS1	1/2 line	1
VIS1	1/2 line	1
VIS2	1/2 line	2
VIS2	1/2 line	2
VIS1	1/2 line	2
VIS1	1/2 line	2
VIS2	1/2 line	3
VIS1	1/2 line	2499
VIS1	1/2 line	2499
VIS2	1/2 line	2500
VIS2	1/2 line	2500
VIS1	1/2 line	2500
VIS1	1/2 line	2500

Conclusion: 1 sf = 8 fr

AW-format

Heading: 42 sf = 336 fr
Data: 2500 sf = 20000 fr

WV	line	1
WV	line	2
WV	line	3
WV	line	4
WV	line	5
WV	line	6
WV	line	7
WV	line	8
WV	line	9
WV	line	2495
WV	line	2496
WV	line	2497
WV	line	2498
WV	line	2499
WV	line	2500

Conclusion: 1 sf = 8 fr

AIW-format

Heading: 42 sf = 336 fr
Data: 5000 sf = 40000 fr

IR	line	1
WV	line	1
IR	line	2
WV	line	2
IR	line	3
WV	line	3
IR	line	4
WV	line	4
IR	line	5
IR	line	2498
WV	line	2498
IR	line	2499
WV	line	2499
IR	line	2500
WV	line	2500

Conclusion: 1 sf = 8 fr

AIVH-format

Heading: 42 sf = 336 fr
Data: 5000 sf = 40000 fr

IR	line	1
VISH	line	1
IR	line	2
VISH	line	2
IR	line	3

BW-format

Heading: 84 sf = 336 fr
Data: 625 sf = 2500 fr

WV	line	1810
WV	line	1811
WV	line	1812
WV	line	1813
WV	line	1814

BIW-format

Heading: 84 sf = 336 fr
Data: 1250 sf = 5000 fr

IR	line	1810
WV	line	1810
IR	line	1811
WV	line	1811
IR	line	1812

VISH	line	3
IR	line	4
VISH	line	4
IR	line	5
IR	line	2498
VISH	line	2498
IR	line	2499
VISH	line	2499
IR	line	2500
VISH	line	2500

Conclusion: 1 sf = 8 fr

WV	line	1815
WV	line	1816
WV	line	1817
WV	line	1818
WV	line	2429
WV	line	2430
WV	line	2431
WV	line	2432
WV	line	2433
WV	line	2434

Conclusion: 2 sf = 8 fr

WV	line	1812
IR	line	1813
WV	line	1813
IR	line	1814
IR	line	2432
WV	line	2432
IR	line	2433
WV	line	2433
IR	line	2434
WV	line	2434

Conclusion: 2 sf = 8 fr

BIVW-format

Heading: 84 sf = 336 fr
Data: 2500 sf = 10000 fr

IR	line	1810
VIS2	1/2 line	1810
VIS2	1/2 line	1810
WV	line	1810
IR	line	1811
VIS2	1/2 line	1811
VIS2	1/2 line	1811
WV	line	1811
IR	line	1812
VIS2	1/2 line	2433
WV	line	2433
IR	line	2434
VIS2	1/2 line	2434
VIS2	1/2 line	2434
WV	line	2434

Conclusion: 2 sf = 8 fr

BIV-format

Heading: 84 sf = 336 fr
Data: 3125 sf = 12500 fr

IR	line	1810
VIS2	1/2 line	1810
VIS2	1/2 line	1810
VIS1	1/2 line	1810
VIS1	1/2 line	1810
IR	line	1811
VIS2	1/2 line	1811
VIS2	1/2 line	1811
VIS1	1/2 line	1811
VIS1	1/2 line	2433
IR	line	2434
VIS2	1/2 line	2434
VIS2	1/2 line	2434
VIS1	1/2 line	2434
VIS1	1/2 line	2434

Conclusion: 2 sf = 8 fr

LXI-format

Heading: 84 sf = 336 fr
Data: 1250 sf = 5000 fr

IR or VIS	line	1
IR or VIS	line	2
IR or VIS	line	3
IR or VIS	line	4
IR or VIS	line	5
IR or VIS	line	6
IR or VIS	line	7
IR or VIS	line	8
IR or VIS	line	9
IR or VIS	line	1245
IR or VIS	line	1246
IR or VIS	line	1247
IR or VIS	line	1248
IR or VIS	line	1249
IR or VIS	line	1250

Conclusion: 2 sf = 8 fr

Our Primary Data User Station

Radio Frequency Section

These are the components of our RF section:

a) A 2-meter parabolic dish with an f/d ratio of 0.35.

b) A cylindrical horn, 13.2cm long and 13.4cm in diameter, at the focus of the dish. Inside the horn, a quarter-wave monopole (probe) 3.8cm long is placed at 4.4cm from the horn's back. The monopole, which should be placed horizontally (for readers near to zero degrees longitude), is soldered to a BNC coax connector.

c) The preamplifier (LNA) is connected directly to the horn output BNC, and the converter is placed at the rear of the dish. We assembled a LNA kit supplied by RIG and use a downconverter that converts 1694.5MHz to 137.5MHz.

d) The receiver is an ICOM IC R-7000 on whose rear panel there is a jack that outputs a 10.7MHz 2nd-IF signal. We use this signal to drive our HR decoder. This jack also sources 9V dc, so the input capacitor in the 10.7MHz filter/amplifier (Fig. 4) is essential.

A strong RF signal from Meteosat is essential to display the HR images. We recommend a dish not smaller than 2 meters and a really low-noise LNA, otherwise you may have a lot of difficulties in decoding the HR data.

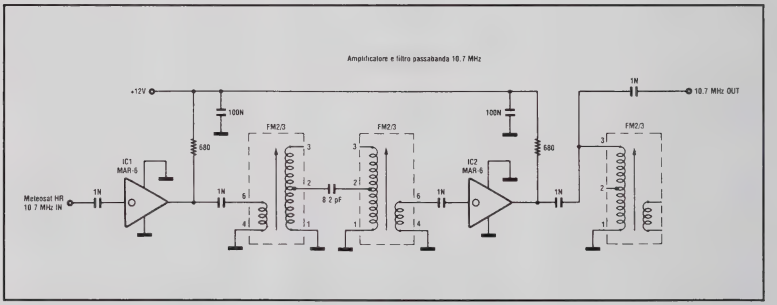


Fig 4. 10.7MHz amplifier and band-pass filter.

10.7-MHz Amplifier and Band-pass Filter

See Fig. 4. As the signal level from the 10.7MHz output of the R-7000 is very weak, we need amplification to drive the following stage. We use two MAR-6 MMIC (IC1,

IC2) and three small 10.7MHz IF transformers marked FM2-FM3. A white dot marks the input of the MAR-6 and the output is the pin on the opposite side. The other two pins must be grounded. The bandwidth should be about 660kHz at -3dB. *This is a critical section of the system. If you do not have the proper test equipment (as is our case), you will have to adjust it on the satellite signal for a noise-free picture. The almost continuous presence of Meteosat's HR signal helps a lot with the final adjustment. Even with encrypted images, you can test the clock frequency (166660Hz), and the waveform on an oscilloscope; you can also display a pepper-and-salt image on the screen.*

Phase Demodulator

See Fig. 5. This section demodulates the 10.7MHz RF signal and supplies a split-phase-low (Manchester) coded signal. The demodulator is based around a MC 1496 (IC3) whose output, after passing through a low-pass filter (IC4), controls the 10.7MHz VCO (TR2 and FM1) which, in turn, provides the reference frequency to the MC 1496 phase detector. *Adjust FM1 for a frequency of 10.7MHz. The TUNE pot (R1), to be placed on the front panel, fine-tunes the VCO frequency. R2 establishes the proper voltage to drive varactors D1-D2. A dual-channel oscilloscope connected to the VCO output and to the split-phase modulated input will show when the two signals are phase locked.* The post-detection filter (R3-4 and C1-2) is designed to cut above twice the bit rate (333.32kHz).

Split-Phase-Low to Nonreturn-to-Zero Decoder

See Fig. 6. The decoding process is based on an HD-6409 Manchester encoder-decoder (Harris Corporation), a chip that converts Manchester code into NRZ code and provides clock recovery. After being regulated at 5V level by IC7, the SPL data is fed into the decoder's Unipolar Data Input (UDI) pin. *Adjust R5 for a 5V level at pin 7 of IC7.*

The HD-6409's SDO (Serial Data Out) provides decoded serial NRZ data synchronous with the decoder clock (DCLK). The decoder requires an oscillator with a frequency 16x or 32x the bit rate. The HD-6409's speed selector (SS) pin (17) sets this, with SS low producing a 16x clock and SS high a 32x clock. We use the 32x mode, so the frequency of the free-running oscillator should therefore be 5333.12kHz for clock synchronization with the incoming data (166.66kHz x 32 = 5333.12kHz). FM1 is a 10.7MHz IF transformer, but the capacitors make the circuit oscillate at a lower frequency. *Adjust FM1 for a frequency of 5333.12kHz at CO (pin 11), or 166.66kHz at DCLK (pin 8). A frequency counter connected to the clock output (DCLK) via a 1kΩ resistor is very useful in showing when the internal clock is locked to the incoming data rate (166.66kHz).*

IC8's reset ($\overline{\text{RST}}$) pin provides control of the decoder outputs. When $\overline{\text{RST}}$ is low, SDO and DCLK are forced low. $\overline{\text{RST}}$ is connected to the error detector in order to

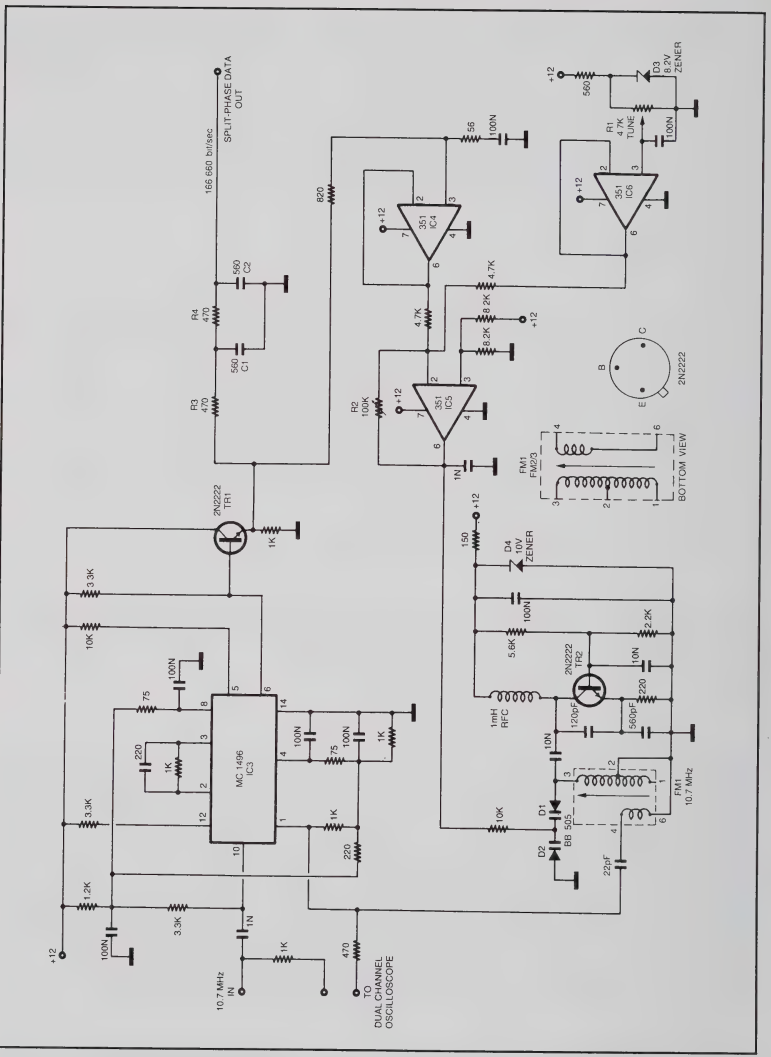


Fig 5. Phase demodulator

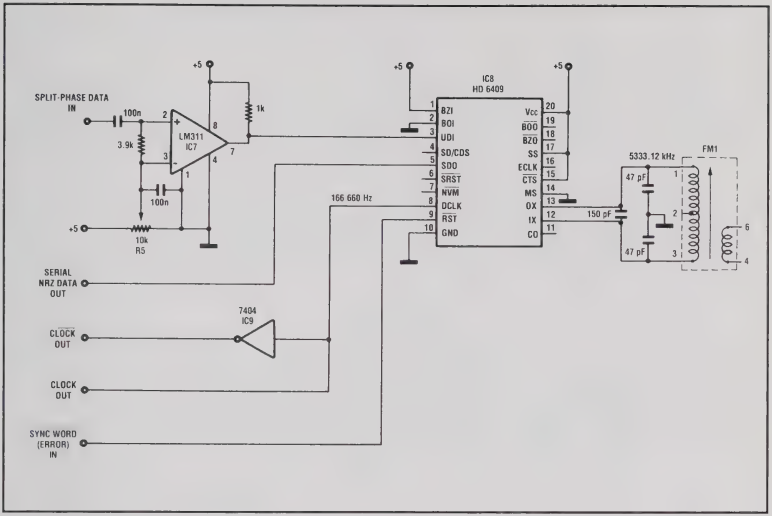


Fig 6. Split-phase-low to non return-to-zero decoder.

resolve the ambiguity problem. If a phase error ($\overline{\text{sync word}}$) is detected by IC18-20 (Fig. 7), the clock error generated is fed to $\overline{\text{RST}}$ so that the phase of the clock is changed by 180°.

Serial-to-Parallel Converter, Line Start, Error and Format Detector

See Fig. 7. This section:

a) Performs the serial-to-parallel conversion.
b) Generates the subframe sync (line start) at the last bit of the fourth word of each subframe.
c) Generates the $\overline{\text{sync word}}$ (error) if it detects a phase error (that is, if the value of the bits is inverted).
d) Generates the format-ID pulse: high for A-format, low for B- and X-formats.
e) Feeds the parallel data into the DMA Computer Interface (Fig. 9) subdivided into bytes corresponding to the data words.

The serial-to-parallel conversion is performed by passing the serial data through a 32-bit shift register (IC10-13) clocked by $\overline{\text{DCLK}}$. The eight data lines are derived from the first register (IC10) and are fed into a D-type register (IC21) that is clocked

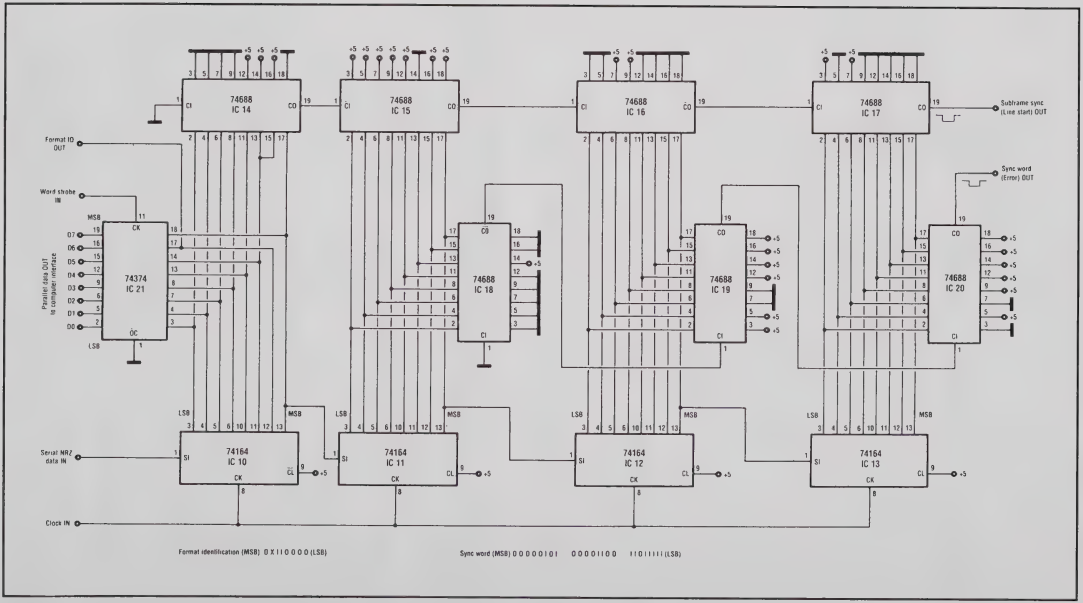

74688 IC 14
74688 IC 15
74688 IC 16
74688 IC 17
74688 IC 18
74688 IC 19
74688 IC 20
74374 IC 21
74164 IC 10
74164 IC 11
74164 IC 12
74164 IC 13
Format ID OUT
Word strobe IN
Parallel data OUT to computer interface
Serial NRZ data IN
Clock IN
Subframe sync (Line start) OUT
Sync word (Error) OUT
Format identification (MSB) 0 X 1 1 0 0 0 0 (LSB)
Sync word (MSB) 0 0 0 0 0 1 0 1 0 0 0 0 1 1 0 0 1 1 1 0 1 1 1 1 1 1 (LSB)

Fig 7. Serial-to-parallel converter, line start, error and format detector.

by the word strobe (a high at the end of each word). The 8 parallel lines are connected to the DMA Computer Interface (Fig. 9).

When the 32nd bit of each subframe enters the first register (IC10), a low (subframe sync or line start flag) is generated at pin 19 of IC17. The subframes of high-resolution VIS formats contain only a half image line, therefore in these formats there is a start flag each half line.

The second most significant bit of the fourth word (ID-word) of the first frame is not used to generate the subframe sync flag, but is used to recognize format: when the subframe sync pulse is generated, if this bit is high the format is A, if this bit is low the format is B or X.

This section also detects the inverted sequence (in IC18-20) in order to resolve the ambiguity problem. The effect of a phase error is that the data appears inverted (0 instead of 1 and vice versa). This situation is detected by checking the serial data for sync word as well as sync word and correcting the clock if sync word is found. This error signal, generated at pin 19 of IC20, is fed into the $\overline{RST}$ input of the HD-6409 (IC8) decoder.

Word Strobe Detector

See Fig. 8. This section performs these functions:

a) It divides the flow of clock pulses into blocks of 8 bits that correspond to the bytes or words of the data, and provides a pulse (word strobe) at the last (eighth) bit of each word.
b) It signals with D5, a front-panel-mounted LED, that the system recognizes the subframe sync (line start); that is, the repetitive sequence situated at the beginning of each subframe (line).
c) It counts the words and resets the system at the end of each subframe: after 4 frames for B-and X-formats, after 8 frames for A-format.

When the subframe sync pulse (line start) is fed into the IC23A's CK input, Q goes high and therefore the clock pulses pass through IC24A and reach IC23B-25A-25B, which divide the frequency by 8, thus generating the word strobe (20.8325kHz): a pulse at the end of each 8-bit word.

The word strobe:

1) Drives IC21 of Fig. 7 to signal that the 8 bits present at its output are an image word.
2) Drives counters IC26-28, the outputs of which are connected to the inputs of

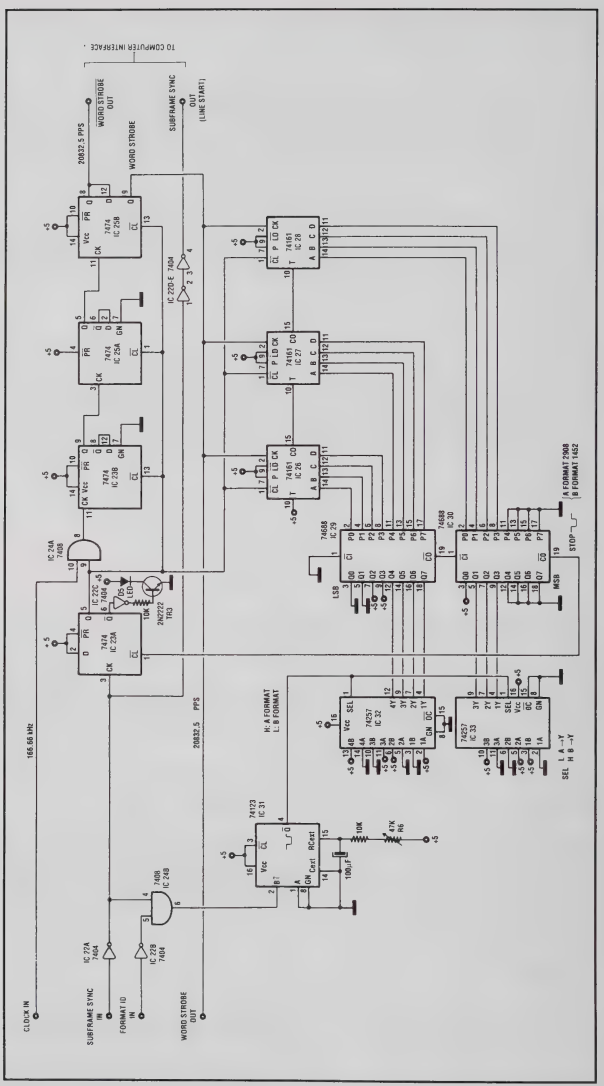


Fig 8. Word strobe detector.

the stop comparators (IC29-30). The stop pulse (a low at pin 19 of IC30) is generated at the end of each subframe. The number of bytes (words) in a subframe varies according to the format (2912 for A-format; 1456 for B- and X-formats); therefore, excluding the first 4 bytes of each subframe, the last byte of A-format subframes is 2908, and the last byte of B- and X-format subframes is 1452. The subframe stop pulse ($\overline{P=Q}$) resets IC23A whose output Q goes low, thus blocking the flow of the clock towards the divider by 8, and resetting counters IC26-28.

Both the subframe sync and the format-ID pulses are applied to an AND (IC24B). When A-format is transmitted, input 5 of IC24B remains low, therefore, in the absence of a signal at pin 2, output $\overline{Q}$ of monostable IC31 always remains high. When B- or X-formats are transmitted, input 5 of IC24B goes high together with input 4, therefore a high reaches input B of monostable IC31. Consequently $\overline{Q}$ goes low and remains low for the whole length of the image. In fact, the values of the RC cell on pin 15 are such that $\overline{Q}$ is kept low for a time longer than that of a subframe, and the monostable is retriggered at each subframe. Hence, $\overline{Q}$ of IC31 is always high during the transmission of images of A-format, and always low for those of B- and X-formats. *Adjust R6 so that $\overline{Q}$ of IC31 always remains low during the transmission of B- and X-formats.*

In multiplexers IC 32-33 the lines go from A to Y when SEL (pin 1) is low, and from B to Y when SEL is high. Outputs Y are connected to the comparators IC29-30 so that the latter generate the $\overline{P=Q}$ signal (subframe stop) after 2908 words for A-format, and after 1452 words for B- and X-formats. Thus the system is reset at the end of each subframe regardless of the subframe length.

Word strobe and subframe sync are sent to the direct memory access (DMA) computer interface (fig. 9) by means of separate shielded cables.

DMA Computer Interface

See Fig. 9. This board, which installs in an expansion slot on the PC system board, performs these functions:

a) It activates the data input when requested by the receive software; then it resets the DMA request.

b) It recognizes the line start pulse generated by IC17.

c) It makes a direct memory access request for the PC whenever a data item is acquired.

The three buffers IC38, IC39 and IC42 isolate the PC bus from the rest of the board. IC38 feeds the data into the PC bus. IC41 acts as a memory address decode logic (310_{16}). IC40 is a software-driven switch.

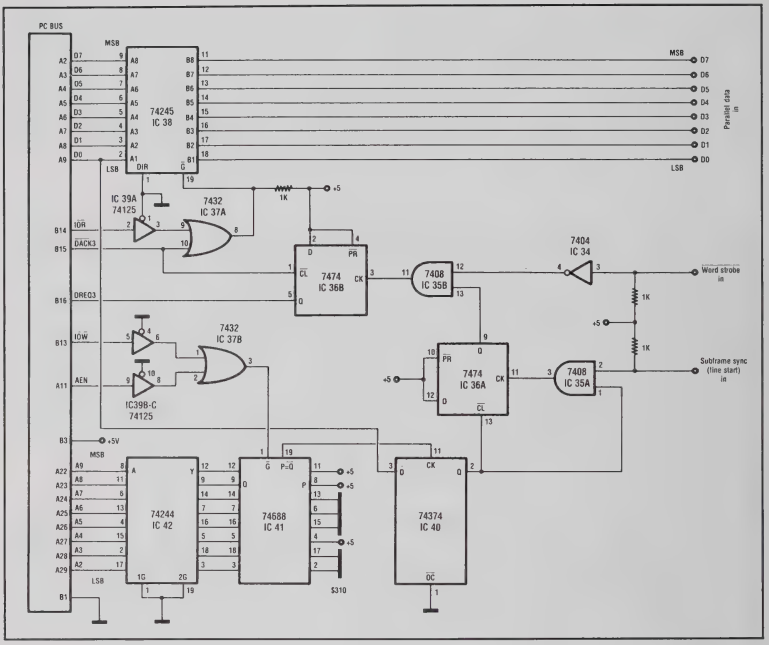


Fig 9. DMA computer interface.

When the software keeps output Q of IC40 (pin 2) high, the line-start signal is applied to IC36A which, in turn, activates IC35B. Under this condition, the word strobe signal reaches IC36B, whose output Q (pin 5) generates a Dma REQuest (DREQ). Then the computer responds by activating the Dma ACKnowledge (DACK) line, which resets IC36B and enables IC38 to feed data (D0-D7) into the data bus.

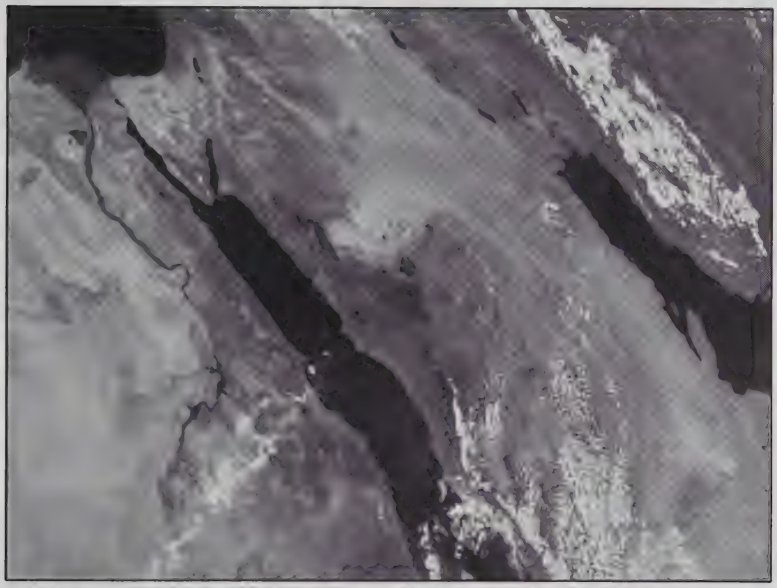
You may have noticed that the DMA Computer Interface is the same as the one of our HRPT receiving system (RIG 45, June 1996, p.42). As a matter of fact, it can accept HRPT, HR and APT/WEFAX data. This means that, with the addition of the appropriate hardware, you can display WX images of any mode transmitted by any spacecraft.

PC

Our computer is a 486DX, 33-MHz machine with 4 megabytes of RAM. The hard disk is a 340Mb Western Digital with a VESA controller; it has 15ms access time. The

Table 2
Meteosat HR System Characteristics

Frequency	Channel A2: 1694.5MHz
Polarization	Linear, in the Equatorial plane
Carrier modulation	Digital split-phase-low
Bit rate	166660 bits/sec
Bits/word	8 (MSB transmitted first)



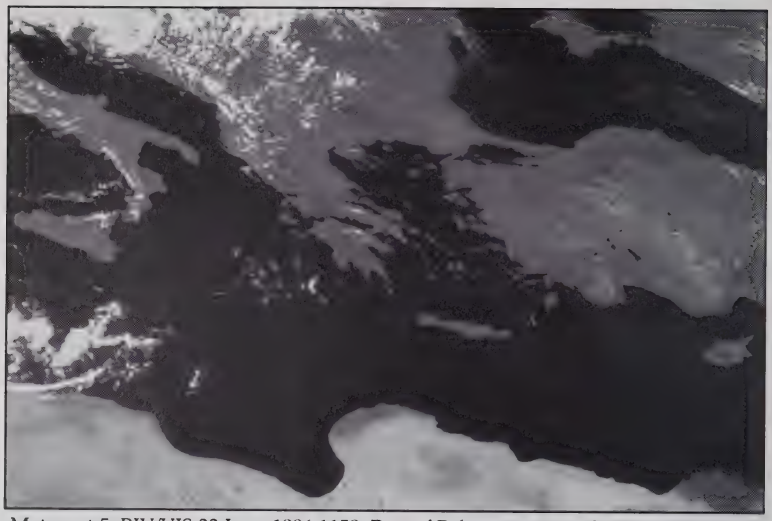
Meteosat 5, AV 10 July 1996 1134. The maximum resolution that Meteosat can provide.

video adapter card is a Cirrus 5428 with 1Mb of memory.

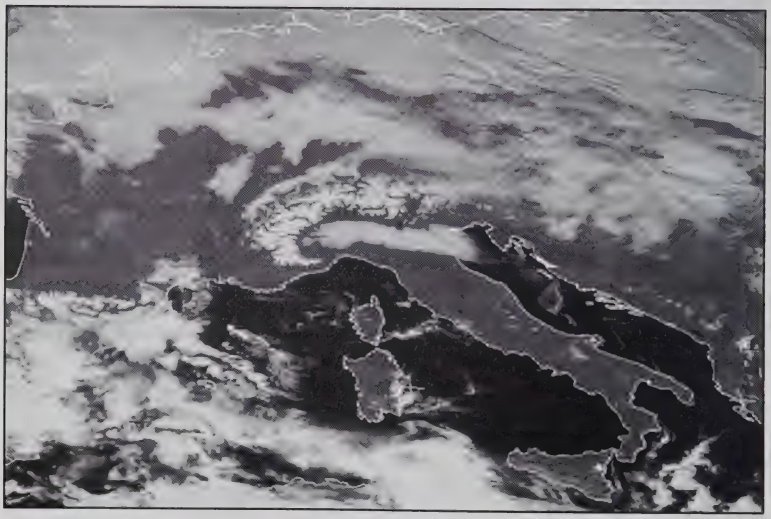
The length of the image files differs greatly according to the formats: it goes from 0.75Mb for BW to 25Mb for the full-resolution VIS image of AV-format.

Software

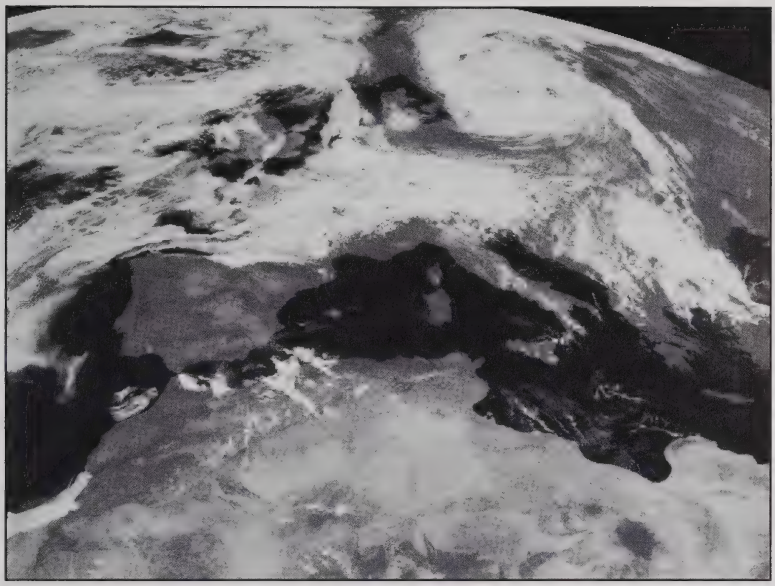
We used Turbo Pascal as our programming tool. The program, produced by



Meteosat 5, BIV/VIS 23 June 1996 1158. Part of B-format rectangle.



Meteosat 5, BIV/VIS 23 June 1996 1158. Europe with coastlines superimposed.



Meteosat 5, BIV/VIS 10 July 1996 1158. Low resolution zoom on Europe.

Giampaolo, IW4CSG, covers HR Meteosat as well as HRPT and APT/WEFAX, but this article does not deal with the hardware necessary for the latter. The pictures can be displayed in various formats, stored on disk and processed (zoomed, enhanced, gridded, and cleaned if single pixels or lines have got lost because of noise). For the installation of the program and the operating instructions, see the file README.TXT.

The software is free, is not copy-protected and can be downloaded as HAMVIEW.ZIP from the RIG BBS. ⊕

RIG JOURNAL BACK-ISSUES

Back-issues of the journal have always been in demand and, in the past, the annual growth in our membership has almost always been under-estimated. This has resulted in depletion of journals from the original print run and the substitution of inferior quality photocopies for most of the earlier issues.

From the start of 1994 the print run was increased considerably and we do not envisage having to resort to photocopies in the forseeable future. With the increased membership and the increased print over-run, the unit cost of a journal has remained substantially unchanged for several years now which is one reason why the membership subscriptions have remained the same for a long time.

We thoroughly recommend that new members, especially those to whom remote imaging is new, buy a couple of years' back-issues. Many beginners' questions are answered and, by buying them, you help to delay the next increase in subscriptions. The full index of contents, which is available from RIG's shareware library and also the BBS, has been updated to include the 1995 issues but here is a summary of the main contents for 1994 and 1995.

The March 1994 issue had a pronounced Russian/Ukranian touch with coloured pictures of a Meteor satellite and several close-up views of an Okean-type craft. Also, there were articles on Okean and two on Meteor 3-5 topics and a look back at the early days of the Soviet weather satellite scene.

The JVFAX software became very popular and there were several comprehensive articles during the year relating to JVFAX and interfaces. Several antenna-related topics appeared in in the June issue, including full construction details for a patch antenna. In September images of another planet, Jupiter, appeared in the Journal for the first time following the comet collision with that planet.

The year ended with a thick, 112-page issue covering a range of topics: Part 1 of an in-depth series on Meteosat, de-mystifying HRPT reception, an antenna primer, a report on the NOAA 13 failure and images of the Rabaul Caldera eruption. Peter Wakelin's image interpretation series continued during the year with global circulation, infrared images, contrast across a weather front and sun glint as the main topics.

1995 saw the start of the rapid growth in Internet access by members and several articles appeared on this topic. A two-part beginners' guide to APT appeared and the year saw the beginning of the highly successful RIG*sat* RX1 project with several articles on this subject and, in December, on the IF1 too. Antenna construction is very popular and this topic was well covered during the year.

The image interpretation series continued with the topics covered being water-vapour imagery, animated sequences of images and mist and low cloud dispersal. The December issue included a report on the record-breaking Atlantic hurricane season with numerous images.

EUREKA! A POSSIBLE CURE FOR PAGER INTERFERENCE

Hugh Pearson (G7KET)

I was in the bath at the time. I'd had a long, busy day and was enjoying 'a nice soak'. As I lay there, my mind wandering from one thing to another, I found myself ruminating on two articles I'd just read in RIG journal No. 41. The Radiocommunications Agency, you may recall, had kindly undertaken some tests to help ascertain whether inadequate receiver performance was a major factor in the problems many members were having with pager interference. The observations by John Tellick and Ray Godden on the outcome had made both encouraging and gloomy reading.

On the positive side, whilst there was obviously room for some improvement, all the receivers tested came out with a reasonably clean bill of health. On the other hand both left the reader with the inevitable conclusion that if you suffered from 'Pager Plague' there was little you could do about it, and that things were likely to get worse as the pager network expands.

Then I had a bright idea, and with a shout of "NULL STEERING!", I leapt from my bath in time-honoured fashion and headed for the Global Radio Communications Facility (alias our fourth bedroom), clad only in a somewhat soggy dressing gown.

Much delving about in back-issues of the Radio Society of Great Britain (RSGB) journal, RadCom, and various other radio text books and publications then followed. I emerged a couple of hours or so later, none the cleaner but much the wiser and firmly convinced that there might indeed be an electronic solution to this growing menace.

'Null Steering' - the theory

It is a fact of physics that if you add two identical waveforms together in complete anti-phase with each other, taking care to ensure that they are also of exactly the same amplitude, the result is zero.

Fig 1a shows two signals, X and Y, of different amplitudes but with the same frequency and exactly in phase with each other. Under these conditions, adding the two waveforms together electronically results in a sine wave (Z) of the same frequency as the originals but with an amplitude that at any one time is the sum of the individual components.

In Fig 1b, signal Y has been phase-shifted by 180° (ie delayed by half a wavelength) with respect to X. In this case the output from the mixing circuit (Z) will again be a waveform of the same frequency as X and Y but, because they are now in complete anti-phase with each other, the amplitude at any given moment will be the differ-

ence in their respective values.

If, as in Fig 1c, the amplitudes of X and Y are made equal and their phase relationship remains unchanged at 180° (thus making the two signals mirror images of each other), then the two waveforms will disappear completely when added together. There's nothing magic about this process; it's just maths in action.

So, in theory, if you have a situation where a signal of particular interest is being degraded by another unwanted one, and you're able to obtain an identical version of the interference that is clean of the wanted signal, by matching their amplitudes and then adding the two together in anti-phase, you should be left with only the one that you wish to hear.

This method of removing unwanted in-band interference does indeed work in practice and has the great advantage over conventional filters in that, if the system is correctly set up, it should not reduce the level or compromise the quality of the wanted component to any significant extent. The only slight drawback is that the extra aerial and its associated circuitry will contribute a small amount of noise to the overall output.

Whilst these graphs illustrate the principle involved using simple sine waves, this cancellation technique works just as effectively with complex waveforms. Furthermore, it can be applied equally well to audio or RF signals and the circuitry required is not particularly sophisticated, though good RF circuit design and careful construction methods become increasingly essential as you get up into the VHF/UHF bands.

Incidentally, this idea was being used on HF radio signals as early as the 1930s and I believe the term 'null steering' also comes from this era. You use the controls that adjust the amplitude and phase relationships between the two signals to 'steer' the mixing circuit into the condition where one 'nulls' the other out.

A working 'null steering' system for 137MHz Pager Interference

Until relatively recently, the only circuits I'd

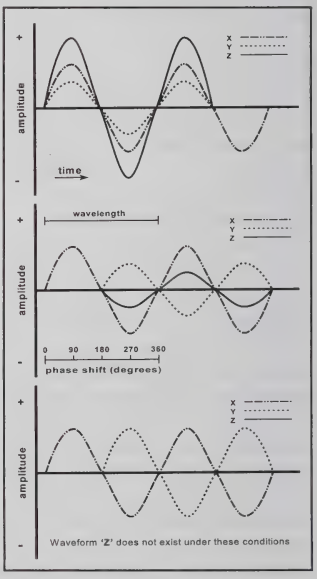


Fig 1. a(top) b(centre) c(bottom)

come across for such devices were designed for use on the HF bands (2-30MHz), where local HF interference (QRM to the radio amateur) can be a real menace when trying to work distant or weak stations. I'd built a couple of these and also used a commercial unit made by SEM (their famous 'QRM Eliminator') and found that all of them produced a startling reduction in the level of *locally* generated interference under most listening conditions.

However, in April 1992, Trevor Day (G3ZYY) published a circuit in RadCom which employed these techniques to null out local QRM in the 2m amateur band (144-146Mhz). This article is reprinted elsewhere in this Journal.

Since the satellite band and the pagers are only a few MHz down from the radio amateurs, it was with a good deal of hope that I contacted Trevor to find more about the design of his circuit. He greeted my enquiries with great enthusiasm and provided me with various component value changes to enable it to function at 137MHz.

Armed with a load of paperwork to back up my researches, I introduced this idea to a meeting of the Bristol area RIG group. It received a mixed reception but Barrie Stevens and I decided to give it a go. The initial results show great promise but we have to admit that both the units we've built, whilst being surprisingly effective in their current form, will not eliminate pager interference completely.

There's nothing wrong with the basic theory, nor indeed with Trevor Day's excellent circuit. The problems encountered are, we believe, a direct result of the methods we're currently using to receive the circularly polarised signals from satellites and the fact that these are being contaminated by terrestrial transmissions of a fixed polarisation. However, I'm sure these snags can be overcome and that this approach offers the very real prospect of a reliable antidote to pager interference.

Permission to publish Trevor Day's circuit in this Journal was sought for two specific reasons. The first was to show just how we'd reached the point we're at today. The second was to stimulate debate, research and further development of this idea by RIG members, in the certain hope that this will result in a set-up that totally eradicates the pager component from our precious satellite signals.

So if you've got this far without succumbing to the inevitable urge to have a look at the RadCom article, may I suggest that now's probably a good time to give in to temptation. What follows will make much more sense if you do.

The G3ZYY / RSGB circuit

Building this circuit should present few problems to anyone who's adept with a soldering iron and blessed with an average degree of patience. The RadCom article

contains all you need to know to make a successful unit. Above all, don't be put off by the fact that you'll need to draw up and etch the pcb yourself. Even though it's a double sided one, there's nothing complicated about it.

The component value changes suggested by Trevor to enable the unit to cover the 137MHz satellite band are as follows:

Coils L1, L2, L3, L4: Increase to 9 turns.
RFC (x3): Change to 27µH
DL1: 71cm (RG174 coax)
Coax loops for S3 (x11): 6.5cm (RG174 coax)

NOTE: Use the pcb track layout printed here and not the one in the 1992 RadCom which contained an error. Also, several slight adjustments have been made to the position of the pads associated with coils L1 - L4 to allow for the added turn in the 137MHz version.

WARNING! There is currently no provision in this circuit to enable a mast-head preamp to be powered via the coax. If your receiver can be configured to do this, be sure that this facility is disabled before connecting the two together. Failure to do so will almost certainly result in damage.

Other points worth considering are:

RV1 (fine phase control)
Trevor Day suggests making this a multi-turn pot. I've found that two good quality standard pots in series (250k + 20k) also works well, and this option has the advantage of making homing in on the approximate null-point very quick and easy, whilst still preserving the fine-adjustment facility.

RV3 (auxiliary signal amplitude control)
Make this two pots rather than one for the same reason as above (2k + 250Ω).

RV2(main signal amplitude control)
This is a 'preset' and should not need altering once the system is up and running. However, putting this control on the back panel of the unit (rather than on the pcb) will make the experimentation process very much simpler. If you choose to do this, be sure to make the connection to the pcb with a piece of RG174 coax, as per RV3.

Incidentally, the justification for having such precise control over amplitude and phase is that research by an American defence communications firm back in the early 1980s indicated that the depth of null obtainable for local interference (ie up to about 30km) is limited only by how finely these controls can be adjusted.

Some Other Practical Points

For a total 'null' to be achieved, the *complete system* must enable the following conditions to be satisfied at the point where the two signals are mixed together:

- *the two signals must be stable with respect to each other*
- the amplitude of both components must be equal
- the waveforms concerned must be identical
- *the phase relationship between the two must differ by exactly 180°*

Signal Stability

This requirement is not too difficult to realise, provided you pay attention to the following points:

Both aerials should be mounted outside the house if at all possible.

Main aerial
If using a turnstile', try experimenting with its *horizontal* orientation to see whether there's a point at which the pager's signal is at a minimum.

Whilst every little helps, don't expect to get a large reduction in signal by rotating the aerial. If you do there's something seriously wrong with it! Indeed, a failure to find a minimum is not such a bad thing, as it indicates your turnstile has probably got a good omni-directional response with respect to signals close to the horizon.

Auxiliary aerial
It's vitally important that this picks up as little of the satellite signal as possible. Since the pager transmissions are so strong relative to the signals from space, this aerial does not need to be particularly efficient or sophisticated. Therefore, one designed for a frequency some way above 137MHz is worth investigating.

My current experiments are being conducted with a 430MHz folded dipole as the auxiliary aerial and this manages to provide me with an alarmingly healthy pager signal even when buried in the bowels of a closed steel filing cabinet!

In theory, the aerial of your choice should be mounted with its active element(s) in a vertical plane (rumour has it that all pager signals are vertically polarised) but this is a matter for trial and error.

The auxiliary aerial must not be located in an occupied room in the house. This is primarily because body movement close to the antenna will cause variations in phase to occur. Remember too that indoor aerials are quite likely to pick up interference from the computer and other domestic appliances, and such signals will degrade your

ultimate picture quality.

Control of Signal Amplitude

This presents no real problems and the circuit seems to cope well with a reasonably wide range of signal strengths.

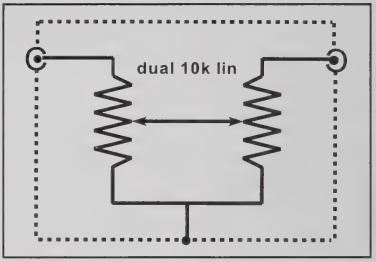


Fig 2.

When experimenting with various types and positions of auxiliary aerial, I've found a variable attenuator of the type shown in Fig 2 to be an essential requirement if my Dartcom receiver is tuned anywhere near to 137.975MHz. Inserting this between the unit and the receiver enables the incoming signal level to be kept within sensible limits. Without it, the moving-coil 'S' meter is in danger of blowing. The attenuator, which should be housed in a small, screened box, is very simple to make and, whilst it makes no pretence at being a constant-impedance device, it's more than adequate in non-critical situations such as these.

The 180° phase relationship

This is where our prototype system runs into problems and the probable cause is that in a conventional turnstile aerial, the short length of coax joining the two dipoles introduces a 90° phase-shift between the two. This is, of course, what gives the antenna its circular polarisation characteristic, but as a consequence the pager waveform that emerges at the end of the coax will be a composite version of two separate signals that have been phase-shifted from each other by 90°. Thus any attempt at nulling this out with one derived from a simple auxiliary antenna can, at best, only ever be partially effective. At least that's our theory.

The same is also likely to be true for crossed Yagis and volutes, though whether any one type is more (or less) successful than the others in this situation remains a matter for further investigation.

There are two other requirements which our experience suggests are essential if the unit is to produce even a reasonable null with pager signals:

- *the two aerials must be as close together as possible*
- the coax cables should be of the same length and type

Fig 3a illustrates a situation where these precautions have not been observed. Due

to the 'path differences', a particular point on the waveform will be approximately four cycles out of step when the anti-phasing process is attempted. Our experiments seem to indicate that the pager's signals change fairly significantly from cycle to cycle, and thus in this case the unit's range of phase adjustment (up to +1 cycle) is insufficient to ensure that two identical waveforms are anti-phased with each other, and so only a rather poor null is achieved.

Fig 3b on the other hand shows a set-up which should work much better. The two aerials receive their signals within half a cycle of each other and this relationship is preserved by matching the lengths of the coax feeding the unit.

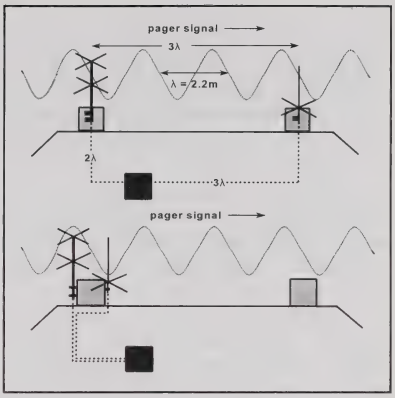


Fig 3. a(top) b(bottom)

Matching the *type* of cable used for the down-leads is also important. Every cable used to convey RF signals has a 'spec'; the most commonly quoted parameter being its impedance However, in this context it's the cable's 'velocity factor' that we're interested in. Velocity factor is the rate at which signals travel down the cable relative to the speed of radio waves in free space. The common RF coax cables, such as URM43, RG58, RG67 (and others with a solid polyethylene insulation), have a VF of 0.66 whereas semi-air-spaced coax (like the type used on TV aerials), those with helical membranes and some 'data cables' can have a VF of between 0.75 and 0.96.

Radio rallies abound with cheap cables of all types. However, unless you're confident that you know what you're doing and to avoid the possibility of introducing an extra source of unwanted phase timing errors into the chain, don't be tempted to use cables of unknown type or origin for this particular purpose.

Future research and development

Several ideas are currently under investigation. The first, and possibly most obvious experiment, involves the use of a second, much smaller turnstile as the auxiliary aerial. If its polarisation and element alignment are identical to that of the main turnstile, will this aerial produce the composite pager signal that seems to be required to achieve the complete null that's eluded us so far? It's a nice thought, but we've a horrid feeling the solution is not going to be this simple!

The other main line of enquiry involves building a new unit based on the schematic diagram shown in Fig 4. In this version the signals from the two turnstile dipoles are treated initially as separate entities and are fed down identical lengths of coax direct to a re-designed phasing unit. The pager component is then removed from of each half in a similar manner to that used in Trevor Day's circuit. Finally, one of the treated signals is phase shifted by 90° before being combined with the other to give the required circular polarisation. This approach sounds hopeful but as the circuit is still at the design stage it will be a quite a while before we can announce any useful findings.

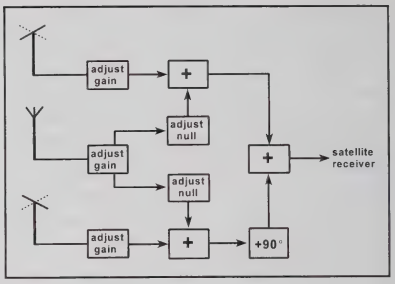


Fig 4.

The astute amongst you will also have realised that those with tracking aerial systems will not be able to 'set and forget' this unit, as the phase of the pager signal it receives will be dependent on the position of the array at the time. Various techniques and hardware to cope with this situation are under consideration.

Acknowledgements

My sincere thanks are due to both Trevor Day and Mike Dennison (G3XDV) not only for consenting to the republication of the original RSGB article but also for their enthusiastic interest in this venture and its ultimate outcome.

In Conclusion

This project, which we code-named EUREKA, has come a long way in the last six months with only Barrie and myself working on it. However, the RIG membership must surely include many with considerably more electronic know-how and technical expertise than we can boast. So come on; get thinking, start experimenting and, above all, share your knowledge, thoughts, successes and failures with the rest of us. We've got to crack this one. As for me and my quest for further inspiration, I think it's about time I had another bath.

FREE: 1.2m fibreglass dish with wooden mast support. Free for any RIG member to collect. Les Currington (Welwyn Garden City) 01707 326058.

KILLING THE PAGER

Barrie Stevens.

This article details my success (and otherwise) in overcoming serious pager interference. However, please note that I am not an expert in RF or antenna theory but, although some of my ideas may not be strictly accurate, they do work in practice.

During 1995 I became interested in remote imaging and joined RIG. At this stage I had no means of receiving but, during December, I built the 5-channel version of the RIGsat RX1. This was followed by the volute antenna described in RIG Journal 37 and my kit was completed with Timestep's PROsat for Windows. The results were very disappointing.

NOAA 12 on 137.5MHz produced reasonable images, although bands of interference were noticeable until the satellite was well above the horizon. NOAA 14 on 137.62MHz had bands of interference throughout the whole image and Meteor 3-5 on 137.85MHz was totally unusable.

A quick check with my scanner discovered that a pager was blasting away on 137.975MHz, the signal being so strong that the scanner would happily receive it with the aerial disconnected and the squelch turned to maximum. My spirits plummeted! I had read about pager interference but had never dreamed it could be as bad as this.

A radio ham at my place of work suggested that I change the volute for a crossed dipole (turnstile). The theory behind this was that, even though both antennas are circularly polarised, the volute's elements are approximately in a vertical plane. As the pager transmitter is vertically polarised the interference would be greater than with a turnstile which has its elements in a horizontal plane. Tests with a home made antenna proved that this was indeed the case but due to TV generated interference I eventually bought a turnstile from Circuit which is now mounted on the roof.

Things were now looking up. NOAA 12 images were clear throughout and NOAA 14 only had interference when the satellite was low in the sky. However, although I could now make out what was on the Meteor 3-5 images they suffered bad interference from end to end (see image in RIG 45).

No further progress was made until I met Hugh Pearson at a meeting of the Local Rig Group. (Bristol). Hugh had brought along a volute he was building and inevitably conversation got around to my experience with a similar antenna. Hugh was confident that he had the answer!

The RADCOM article by Trevor S Day, G3ZYY, which is reprinted elsewhere in this journal, appeared and Hugh explained the theory behind it. I was astounded. If it was this easy why hadn't other RIG members spotted it and mentioned it in the journal? Would it work? Hugh offered to make the PCB for me as he had the facilities to do so. This duly arrived and construction work began in earnest.

Construction

The unit was built as per the specification apart from the rotary switch. Instead of the rather complex one listed in the article I used a simple one purchased from Maplin Electronics (Order code FF73Q, cost 99 pence). Although this does not have a ground plane, it appears to work okay.

The whole thing was very easy to build but care must be taken soldering the small loops of coaxial cable to the rotary switch. Too much heat and the resultant short circuit between the core and screen can be difficult to find! In all it took about three evenings to complete.

Location and Positioning of Hardware

My experience (and many failures) has proved that this is the most critical part of the whole system. I won't describe the problems I had but will simply summarise the setup which gives me the best results to date.

Turnstile
Position this so that one element, (any one) is pointing directly towards the paging transmitter. My theory on this is that due to the phasing harness a Turnstile sends two pager signals down the co-ax, 90 degrees out of phase with each other. By aligning it in the way stated we end up with one very strong signal and one much weaker one. The unit is used to eliminate the strong one and we ignore the other.

Sense Antenna
Keep this very simple. I have tried highly directional Yagis and simple bits of wire. The best results were obtained with 2 pieces of wire forming a simple dipole.

Cable Lengths
Ensure that the co-axial cables between each antenna and the unit are approximately the same length. They don't have to be exact but should be within one wavelength of each other.

Amplifier Settings
I have tried all variations and my best results are achieved with the settings very low and a RIG pre-amp connected between the unit and my receiver (Fig 1). However,

with further experimentation it may well be possible to do away with this.

Setting up the Unit

At first this was my greatest problem as I have no suitable test gear for such a job. Early attempts were very frustrating and slow and any alteration to antenna positions or amplifier settings resulted in my having to start all over again. Eventually I worked out a process for using my hand-held scanner which enabled the best settings to be found in about 10 minutes. This was done with the unit set up for use, that is both aerials connected. The process is described below.

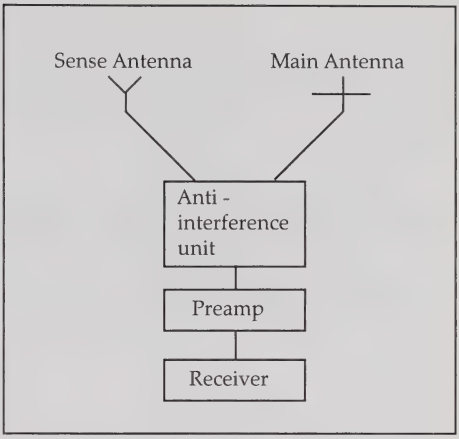


Fig 1.

1. The scanner is set to 137.970MHz which is slightly offset from the actual pager frequency. This setting allows the squelch control to be used to silence the pager signal which is actually on 137.975MHz.

2. The scanner aerial socket is then connected to the output of the unit and the squelch increased until the pager signal is just silenced.

3. The squelch must now be backed off until the pager signal just breaks through and can be heard on the scanner.

4. Adjust the unit as described in the RADCOM article and the pager signal will disappear.

5. Go back to step 3 and keep repeating the process until no further improvements can be made; ie the signal can no longer be silenced.

6. The unit is now at its most efficient setting.

Please note that that this works well with my scanner which is an AOR 2000. With other makes different frequency settings may be necessary.

Results

In my location and with my kit this unit does not totally eliminate interference. However it does reduce appalling pager breakthrough to a level where it is of no consequence. In a better location or with better kit it would probably be totally successful.

Inevitably there is a down side and I have found that the range is slightly reduced with the satellite being slightly higher above the horizon before I can receive it. This does not matter at all as without the unit the additional part of the image is totally ruined by interference anyway. With the unit in place I can receive excellent images of Greenland from Meteor 3-5 and have been fascinated watching the receding pack-ice around the coast.

Conclusion

The unit really does work and can be used to significantly reduce or even eliminate pager interference. However, it is difficult to set up and some experimentation and perseverance may be necessary to gain the best results.

Finally, I must thank Trevor Day and Radcom for publishing the original article and allowing its publication in this journal. I would also like to thank Ray Godden and Bryan Taylor for their hard work in designing and supplying the RIGsat RX1 receiver. Last but not least, thanks to Hugh Pearson for manufacturing the PCB and his constant enthusiasm which gave me hope of success.

CORRECTIONS TO THE CONTRAST ENHANCER (RIG 44)

Sam Elsdon

Two errors have been spotted in the circuit diagrams of the contrast enhancer described in RIG 44. On page 17, in the power supply, the centre tap of the transformer should be grounded. On page 21, the line below C24 should be deleted so that the circuit mirrors the circuit around C27 at the top of the diagram. My apologies for any confusion this may have caused and my thanks to those members who pointed out the errors.

Alan Woodcock has built the enhancer and reports very good results in balancing the brightness of APT visible and IR images as well as adjusting the contrast for a more viewable result. Thanks for the feedback, Alan.

2M INTERFERENCE REDUCTION SYSTEM

Trevor S Day G3ZYY

[Reprinted from *Radio Communication* April 1992]

This circuit will substantially reduce or completely eliminate interference from almost any local source whilst leaving the wanted signal relatively unaffected, even though it may be on the same frequency! Once the unit is adjusted for a particular source of interference, the user is free to operate anywhere in the band without further adjustment.

The design of the circuit limits operation to a small band of frequencies but it is sufficient to cover the entire two metre band. The principle can also be used at 50 and 70MHz in order to remove computer hash. (See issue 28 of the *UK Six Metre Group Newsletter*).

Principle of Operation

The block diagram (Fig 1) shows the method of operation. Both the wanted and interfering signals arrive at pre-amplifier 1 from the main antenna via the antenna switch. The sense antenna, by virtue of its inefficiency at the wanted frequency, picks up predominantly the interfering signal and and passes this to pre-amplifier 2. Both preamplifier outputs eventually add in the signal combiner. However, the interfering signal is first changed in phase by 180°. The resultant output of the combiner is the same as the input to pre-amplifier 1 from the main antenna less the interfering signal.

Circuit Description

Both pre-amplifiers are standard dual gate MOSFET designs, using the 3SK81 device as these were to hand (Fig 2). Almost any common dual gate MOSFET will work in this configuration, eg the 40673. RV3 controls the gain of pre-amplifier 2 and is adjustable from the front panel. Its purpose is to match the level of the interfering signal from preamplifier 2 to the interfering signal from pre-amplifier 1 at the signal combiner, thus ensuring complete cancellation. RV2 is a preset potentiometer controlling the of preamplifier 1 in the wanted signal path from the main antenna.

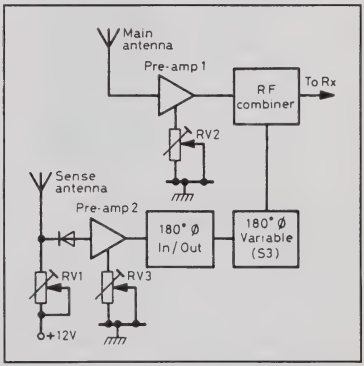


Fig 1. The two signal paths are combined via a phase-shift network.

Pre-amplifier 2 feeds its output to a fixed 180° phase inverter (DL1) formed by an electrical half-wavelength of RG174U miniature 50Ω co-axial cable which may be switched in or out of circuit by the diode switch comprising D6, D7, D8 and S2. A further variable 180° phase shift is achieved by S3. This is a half-wavelength of RG174U cable in eleven sections switched in approximately 16° phase change steps.

The connecting cables from the switch to the pcb should be as short as practically possible (15cm max) as these will introduce additional phase changes. However, these are compensated for by the fine phase control. Fine phase control is achieved by a 1N914 diode acting as a varactor across the input circuit to preamplifier 2. The additional capacitance of the diode, controlled by RV1, alters the input tuning of pre-amplifier 2 but, more importantly, slightly shifts the phase of the signal arriving at the pre-amplifier. The output of the phase switch and of pre-amplifier 1 are both fed to a signal combiner comprising R8, C14, C15, L5 and L6. This is a 50Ω signal splitter operating in reverse. Its purpose is to add both signals and, as the interfering signal in one path is 180° out of phase with its complement in the other path, the interfering signal is drastically reduced or eliminated completely.

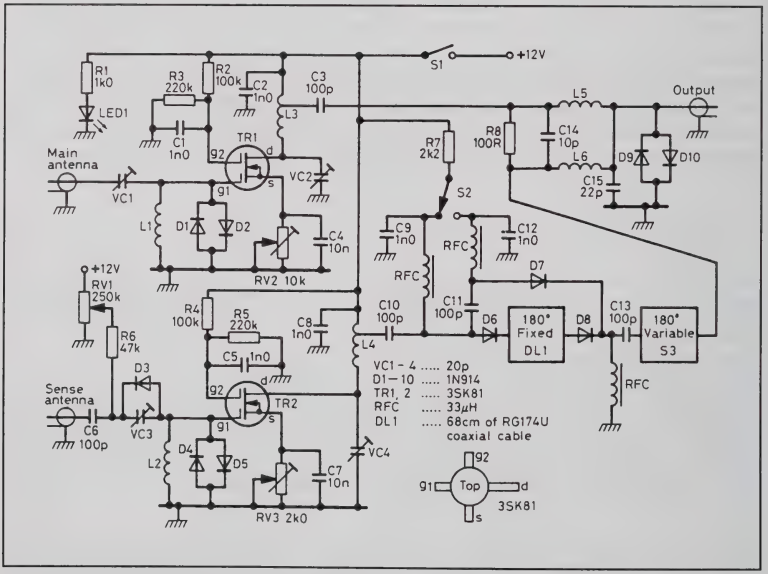


Fig 2. Circuit diagram shows how signals from the two antennas are amplified in a variable gain MOSFET configuration.

Construction

The main PCB is constructed from double-sided glass fibre board; the underside layout is shown in Fig 3. The top side is blank copper. Track widths are not especially critical and the board can easily be marked with a Daylo type pen on the track side and some nail varnish on the reverse. The gate 2 voltage to each pre-amplifier has been derived separately to allow the two 'halves' of the circuit to be separated by screens in order to reduce cross-talk. The screens are constructed from the same double-sided PCB, about 20mm wide and soldered into place prior to mounting the components.

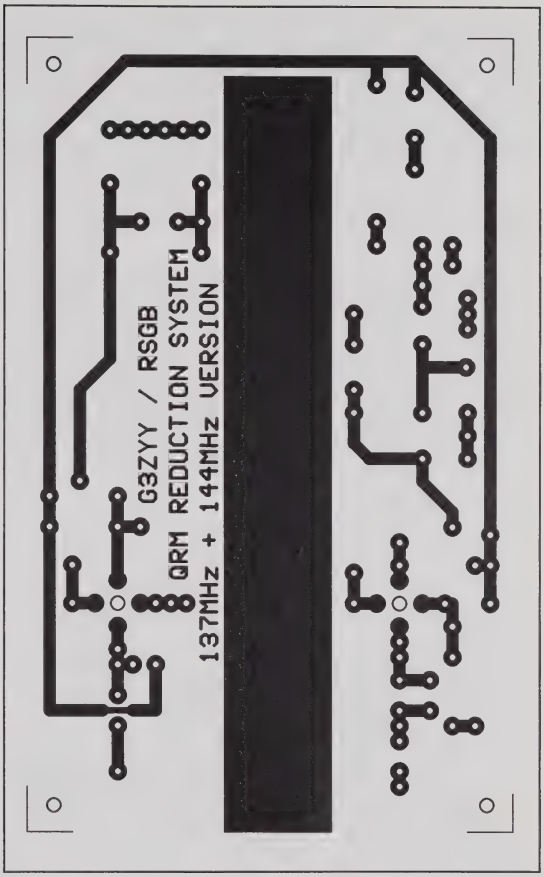


Fig 3. Underside of the PCB, shown actual size.

The phase switch is a twelve-way rotary switch soldered to a PCB carrier which holdsthe eleven loops of RG174U co-ax (Fig 5). The PCB carrier should be fashioned to suit the size of switch used along the lines shown in the diagram. Losses through the switch are not articularly significant as only the amplified interfering signal passes through it. The carrier is made from the same double-sided PCB stock as the main board. When complete, the co-ax loops lie in the same plane as the switch shaft. The fine phase control will compensate for the extra path length through varying sizes of switch;

however, a smaller switch is preferred for compactness. Whichever box is used to hold the device, it should be RF tight. A die-cast aluminium box is ideal and will need to be approximately 203x114x64mm. Component values are not especially critical, although the coil dimensions should be adhered to and the components forming the combiner should be as close to those specified as possible. Note that a small screen is also required to separate L5 and L6 in the signal combiner. The fixed 180° phasing line DL1 may be coiled and taped up for compactness.

Setting Up

Adjustment prior to use is quite straightforward and requires no test equipment.:

a) Power up the unit and connect it between the receiver and main antenna, leaving the sense antenna disconnected.
b) Tune to a weak signal on FM or a carrier on SSB/CW and with the fine phase control at mid position, adjust VC1 and VC2 at pre-amplifier 1 for best signal to noise. Adjust RV2 for optimum signal level at the receiver.
c) Disconnect the main antenna and connect the sense antenna. With RV3 adjusted for a low 'S' meter reading, adjust VC3 and VC4 in pre-amplifier 2 for maximum signal.
d) Reconnect the main antenna.

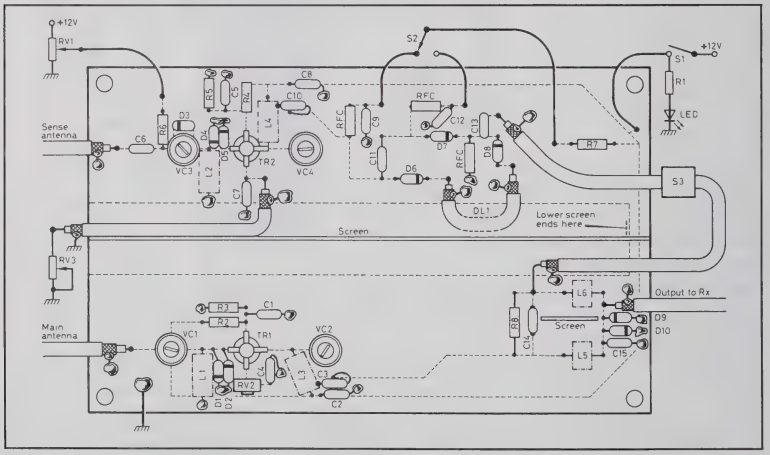


Fig 4. Component layout of the PCB.

PREDICTED TIMES (GMT) FOR AQUISITION OF SIGNAL FOR 52.5 DEG NORTH, ZERO DEG EAST

	NOAA 12 Period 101.27 mins 137.50MHz				NOAA 14 Period 102.06 mins 137.62MHz				OKEAN 4 Period 97.75 mins 137.40MHz				SICH 1 Period 97.78 mins 137.40MHz			
	S' bound		N' bound		S' bound		N' bound		S' bound		N' bound		N' bound		S' bound	
10 Sep	0615	0755	1742	1924	0152	0333	1145	1325	0911	1049	2155	2331	0840	1019	1846	2025
11	0553	0733	1720	1901	0141	0322	1135	1314	0937	1116	2220	2357	0730	0906	1735	1913
12	0711	0851	1659	1839	0130	0311	1124	1303	0826	1004	2245	2424	0756	0934	1802	1940
13	0649	0829	1637	1817	0119	0300	1252	1434	0852	1030	2136	2312	0822	1001	1829	2007
14	0627	0807	1616	1755	0108	0249	1241	1423	0741	0918	2201	2338	0713	0849	1718	1856
15	0605	0745	1733	1914	0238	0420	1231	1412	0807	0945	2227	2405	0739	0916	1745	1923
16	0723	0904	1711	1852	0227	0408	1220	1401	0833	1011	2117	2253	0630	0805	1811	1950
17	0701	0842	1650	1829	0216	0358	1209	1350	0722	0859	2142	2319	0655	0831	1700	1838
18	0640	0820	1628	1807	0206	0347	1159	1339	0748	0926	2208	2346	0721	0859	1727	1905
19	0618	0758	1745	1927	0155	0336	1148	1328	0814	0952	2058	2234	0612	0747	1754	1933
20	0556	0736	1724	1905	0144	0325	1137	1317	0703	0840	2123	2301	0638	0814	1643	1820
21	0714	0854	1702	1842	0133	0314	1127	1306	0729	0906	2148	2327	0703	0842	1710	1848
22	0652	0832	1641	1820	0122	0303	1255	1437	0755	0933	2039	2215	0555	0730	1559	1737
23	0630	0811	1619	1758	0111	0252	1244	1426	0644	0821	2104	2242	0620	0757	1625	1803
24	0609	0749	1736	1917	0241	0422	1233	1415	0710	0848	1955	2130	0646	0825	1652	1831
25	0726	0907	1714	1853	0230	0411	1223	1403	0736	0914	2020	2156	0713	0852	1541	1719
26	0705	0845	1653	1833	0219	0400	1212	1352	0625	0802	2045	2223	0603	0740	1608	1746
27	0643	0823	1632	1811	0208	0349	1201	1341	0651	0829	1936	2111	0629	0807	1635	1813
28	0621	0801	1611	1749	0157	0338	1150	1330	0717	0855	2001	2137	0519	0655	1524	1701
29	0559	0739	1727	1908	0146	0327	1140	1319	0605	0743	2025	2204	0545	0722	1551	1729
30	0717	0858	1705	1845	0136	0316	1129	1308	0632	0810	1917	2052	0611	0750	1617	1756
01 Oct	0655	0836	1644	1823	0125	0305	1258	1440	0658	0836	1941	2118	0501	0638	1507	1644

	NOAA 12				NOAA 14				OKEAN 4				SICH 1			
	S′ bound		N′ bound		S′ bound		N′ bound		S′ bound		N′ bound		N′ bound		S′ bound	
02 Oct	0634	0814	1623	1801	0114	0254	1247	1429	0547	0724	2007	2145	0527	0705	1573	1711
03	0612	0752	1740	1920	0244	0425	1235	1417	0613	0751	1858	2033	0419	0554	1422	1600
04	0550	0730	1718	1858	0233	0414	1225	1406	0639	0818	1922	2059	0444	0621	1449	1627
05	0708	0849	1656	1836	0222	0403	1214	1355	0527	0705	1948	2126	0510	0648	1516	1654
06	0646	0827	1635	1814	0211	0352	1203	1344	0554	0732	1838	2014	0401	0536	1405	1542
07	0624	0805	1614	1752	0200	0341	1153	1333	0620	0758	1903	2040	0426	0603	1432	1609
08	0603	0743	1730	1911	0149	0330	1142	1322	0508	0646	1929	2107	0452	0630	1458	1637
09	0721	0901	1709	1849	0138	0319	1132	1311	0535	0713	1819	1955	0344	0519	1525	1704
10	0659	0839	1647	1827	0128	0308	1121	1300	0423	0601	1844	2021	0409	0546	1414	1552
11	0637	0817	1626	1805	0116	0257	1249	1331	0449	0627	1910	2048	0435	0613	1441	1619
12	0615	0755	1743	1924	0106	0246	1238	1420	0515	0654	1759	1935	0326	0501	1330	1508
13	0553	0733	1721	1902	0235	0416	1228	1409	0404	0542	1825	2002	0351	0528	1357	1535
14	0712	0852	1700	1840	0224	0405	1217	1358	0430	0608	1851	2029	0417	0556	1423	1602
15	0650	0830	1638	1817	0213	0354	1206	1347	0456	0635	1741	1916	0308	0444	1312	1450
16	0628	0808	1617	1755	0202	0344	1156	1336	0345	0522	1806	1943	0334	0511	1339	1517
17	0606	0746	1734	1915	0151	0332	1145	1325	0411	0549	1831	2010	0400	0538	1406	1544
18	0724	0905	1712	1852	0141	0322	1134	1314	0437	0615	1721	1858	0250	0426	1255	1433
19	0702	0843	1650	1830	0130	0311	1124	1303	0325	0503	1747	1924	0316	0454	1322	1500
20	0640	0821	1629	1808	0119	0300	1252	1434	0352	0530	1812	1951	0342	0521	1348	1527
21	0619	0759	1608	1746	0108	0249	1241	1423	0418	0547	1702	1839	0233	0409	1238	1415
22	0557	0737	1724	1905	0238	0419	1230	1411	0307	0445	1728	1905	0258	0436	1304	1442
23	0715	0855	1703	1843	0227	0408	1219	1400	0333	0511	1619	1753	0150	0325	1331	1510
24	0653	0833	1641	1821	0216	0357	1209	1349	0359	0538	1643	1819	0215	0352	1220	1358
25	0631	0811	1620	1759	0205	0346	1158	1338	0248	0426	1708	1846	0241	0419	1247	1425
26	0609	0749	1559	1736	0154	0335	1147	1327	0314	0452	1559	1734	0132	0307	1314	1452
27	0547	0727	1715	1856	0143	0324	1137	1316	0340	0519	1624	1800	0157	0334	1203	1341

	NOAA 12				NOAA 14				OKEAN 4				SICH 1			
	S′ bound		N′ bound		S′ bound		N′ bound		S′ bound		N′ bound		N′ bound		S′ bound	
28 Oct	0705	0846	1654	1833	0133	0313	1126	1305	0229	0407	1649	1827	0223	0402	1229	1407
29	0644	0824	1632	1811	0122	0302	1254	1437	0255	0433	1540	1715	0114	0250	1118	1256
30	0622	0802	1611	1750	0111	0252	1244	1425	0321	0500	1605	1741	0140	0317	1145	1323
31	0600	0740	1728	1909	0240	0422	1233	1414	0209	0347	1630	1808	0206	0344	1212	1350
01 Nov	0718	0859	1706	1846	0230	0411	1222	1403	0235	0414	1521	1656	0057	0232	1101	1239
02	0656	0837	1645	1824	0219	0400	1211	1352	0124	0302	1546	1722	0122	0259	1127	1306
03	0635	0815	1623	1802	0208	0349	1201	1341	0150	0329	1611	1749	0148	0327	1154	1332
04	0613	0753	1740	1922	0157	0338	1150	1330	0217	0355	1501	1636	0039	0215	1043	1221
05	0551	0731	1719	1859	0146	0327	1139	1319	0105	0243	1526	1703	0104	0242	1110	1248
06	0709	0849	1657	1837	0135	0316	1129	1308	0131	0310	1516	1730	0130	0309	1137	1315
07	0647	0827	1636	1815	0124	0305	1257	1439	0158	0336	1442	1618	0021	0157	1026	1204
08	0625	0805	1614	1753	0113	0254	1247	1428	0046	0224	1507	1644	0047	2338	1053	1231
09	0604	0744	1731	1912	0243	0424	1235	1417	0112	0250	1533	1711	0113	2403	1119	1258
10	0722	0902	1709	1850	0232	0413	1224	1406	0139	0317	1423	1559	0140	2429	1008	1146
11	0700	0840	1648	1828	0221	0402	1214	1355	0027	0205	1448	1625	0207	2321	1035	1213
12	0638	0818	1627	1805	0210	0351	1203	1343	0053	0231	1514	1652	0056	2346	1102	1241
13	0616	0756	1744	1925	0200	0340	1153	1332	0120	0258	1404	1540	0122	0211	0951	1129
14	0554	0734	1722	1903	0149	0330	1142	1322	0008	0146	1429	1606	0150	2303	1018	1156
15	0712	0853	1700	1840	0138	0319	1131	1311	0034	0212	1320	1455	0038	2328	0907	1045
16	0650	0831	1639	1818	0127	0308	1300	1442	0100	2349	1344	1521	0105	2354	0934	1112
17	0629	0809	1618	1756	0116	0257	1249	1431	0126	0306	1409	1547	0132	2245	1000	1139
18	0607	0747	1734	1916	0246	0427	1238	1419	0015	0153	1301	1435	0021	2310	0849	1027
19	0545	0725	1713	1853	0235	0416	1227	1408	0041	2330	1325	1501	0047	2336	0916	1054
20	0703	0843	1651	1831	0224	0405	1217	1357	0108	2356	1350	1528	0115	2227	0943	1121
21	0641	0821	1630	1809	0213	0354	1206	1346	0134	2244	1241	1416	0003	2252	0831	1010
22	0619	0759	1609	1747	0202	0343	1155	1335	0023	2311	1306	1443	0030	2319	0858	1036

	NOAA 12				NOAA 14				OKEAN 4				SICH 1			
	S′ bound		N′ bound		S′ bound		N′ bound		S′ bound		N′ bound		N′ bound		S′ bound	
23 Nov	0558	0738	1725	1906	0151	0332	1145	1324	0048	2337	1331	1509	2209	2345	0925	1104
24	0716	0856	1704	1844	0141	0321	1134	1313	0115	2226	1222	1357	2235	2412	0814	0952
25	0654	0834	1642	1822	0130	0310	1123	1302	0003	2251	1247	1423	2127	2301	0841	1019
26	0632	0812	1621	1800	0119	0259	1251	1433	0030	2318	1312	1450	2152	2328	0908	1046
27	0610	0750	1738	1919	0248	0430	1241	1422	2206	2354	1203	1338	2217	2355	0757	0935
28	0548	0728	1758	1857	0238	0419	1230	1411	2233	2410	1227	1401	2109	2244	0823	1002
29	0706	0847	1654	1834	0227	0408	1219	1400	2259	2437	1253	1431	2134	2311	0850	1229
30	0645	0825	1633	1812	0216	0357	1208	1349	2147	2325	1143	1319	2200	2338	0739	0917
01 Dec	0623	0803	1612	1750	0205	0346	1158	1338	2214	2352	1208	1345	2051	2227	0806	0944
02	0601	0741	1728	1910	0154	0335	1147	1327	2240	2418	1234	1412	2116	2253	0655	0833
03	0719	0859	1707	1847	0143	0324	1136	1316	2129	2306	1124	1300	2143	2321	0722	0900
04	0657	0837	1645	1825	0132	0313	1126	1305	2154	2331	1149	1326	2034	2209	0749	0927
05	0635	0816	1624	1803	0121	0302	1254	1436	2221	2359	1215	1353	2059	2236	0638	0816
06	0613	0753	1741	1923	0111	0251	1243	1425	2109	2247	1105	1241	2125	2303	0704	0842
07	0552	0731	1719	1900	0240	0421	1232	1414	2136	2314	1130	1307	2015	2152	0731	0910
08	0710	0850	1658	1838	0229	0410	1222	1403	2201	2340	1156	1333	2041	2219	0620	0758
09	0648	0828	1636	1815	0218	0359	1211	1352	2050	2228	1046	1221	2107	2246	0647	0825
10	0626	0806	1615	1754	0207	0348	1200	1340	2116	2255	1111	1248	1958	2134	0714	0852
11	0604	0744	1732	1913	0156	0337	1150	1329	2143	2321	1002	1136	2024	2201	0603	0741
12	0543	0722	1710	1850	0146	0326	1139	1318	2031	2209	1026	1202	1915	2050	0630	0808
13	0700	0841	1649	1828	0134	0315	1128	1308	2057	2236	1052	1229	1940	2117	0656	0835
14	0638	0819	1627	1806	0124	0305	1257	1439	2124	2302	0942	1118	2006	2144	0545	0723
15	0617	0757	1606	1744	0113	0254	1246	1428	2012	2150	1007	1143	1858	2032	0612	0750
16	0555	0735	1722	1903	0243	0424	1235	1416	2038	2217	1033	1210	1923	2059	0639	0817
17	0713	0853	1700	1841	0232	0413	1224	1405	2105	2243	0923	1058	1948	2126	0528	0705
18	0651	0831	1639	1819	0221	0402	1214	1354	1953	2131	0948	1124	1840	2015	0554	0733

Operation

As with most electronic devices, operation is simpler to carry out than to describe.

a) Tune to the interfering signal; if it is broadband then attempt to find a peak.
b) Adjust the balance control (RV3) to find a dip in the level of the interfering signal, switching the fixed 180° phasing line in or out as required. It may be a shallow dip, but a dip must be found. If no dip is apparent, then the sense antenna must be adjusted or changed.
c) Rotate the phase switch (S3) to find a deep dip in the interfering signal, adjusting the balance control to maintain the dip. If no deep dip is found, then switch in (or out) the fixed 180° phasing line and try again.
d) Finally adjust the phase control (RV1) for best null, further adjusting the balance if required.

A measure of the effectiveness of the unit can be achieved by switching in and out the fixed 180° phasing line and observing the change in signal level; the effect is quite startling! To achieve optimum results the sense antenna should be remote from the shack as movement of the antenna, or people within the shack, can affect the arrival phase of the interfering signal and make the null unstable. Even if a random short length of wire or whip antenna is used, it should be either outdoors or in the loft and fed to the shack via co-axial cable.

Fig 5. Course adjustment of phase uses a 12-way switch, fitted on a double-sided PCB carrier.

Limitations

The operation of this device relies upon the interfering signal arriving at both antennas in a fixed phase relationship; ie it does not matter what the relative phase difference is as long as it does not change. Additionally, the amplitude of the unwanted signal at each pre-amplifier input must be

relatively constant. In other words, if you change your beam heading then the balance of the circuit will be upset and RV3 will need re-adjustment. The other controls should remain unaltered.

Any active device will add noise to the received signal and this one is no exception. The wanted signal to noise ratio may be degraded slightly but the benefits of reducing interference far outweigh this disadvantage. The system will not remove 'DX' interference as the sense antenna may introduce unwanted signals that are not au-

L1, L2	8t 18SWG 3/16" (4.5mm) id 1/2" (13mm) long.
L3, L4	8t 18SWG 3/16" (4.5mm) id 1/2" (13mm) long, tap at 1 turn.
L5, L6	8t 18SWG 1/4" (6.5mm) id 3/4" (19mm) long.
C1, C2, C5, C8, C9, C12	1nF
C3, C6, C10, C11, C13	100pF
C4, C7	10nF
C14	10pF
C15	22pF
VC1, VC2, VC3, VC4	20pF
RFC	33mH x 3
R1	1k
R2	100k
R3	220k
R4	100k
R5	220k
R6	47k
R8	100R
RV1	250k lin.
RV2	10k lin. preset.
RV3	2k lin.
DL1	68cm RG174U co-ax braiding to earth plane.
TR1, TR2	3SK81
D1-10	1N914
LED	Red or Green

Component list

dible on the main antenna (mains wiring noise etc.). If this proves to be the case, then the sense antenna should be moved to a less noisy location.

To achieve useful results, the difference in strength of the interfering signal at both pre-amplifiers *must* must be able to be compensated for by RV3. The sense antenna must be chosen so that this condition can be met. In essence, understanding the principle of operation will enable best results to be achieved.

Uses

The original reason for devising this circuit was to remove computer hash at 50MHz for which it has proved highly successful. The two metre circuit described here was built as an experimental novelty. However, it has proved to be most versatile and the unit will deal effectively with the following situations:

a) A local packet node or a local amateur desensing your receiver across the 2m band.
b) A local amateur with a 'wide' signal (for whatever reason); unlike a notch filter not only is the 'fundamental' signal removed, but also all in-band spurii. This holds true even if the 'wide' signal is caused by your receiver's lront-end overload; eg from a contest station on a nearby hilltop.
c) Your own, or a neighbour's, computer-generated interference. (Bear in mind that a computer may radiate signals from several sources but only one source can be dealt with at a time).
d) Next door's persistent central heating system noise.

The most impressive demonstration to date has been a local amateur on FM, many dB over 'S9', transmitting at the same time and on the same frequency and another station at 'S5'. Using two receivers in the shack, one with this unit and one without, both transmissions were heard simultaneously without a trace of interference on either.

Conclusion

The unit is relatively easy to construct and is simple in concept. For anyonewho has ever said "It's that ZYY again; what I need is a ZYY filter", then this is it!

Acknowledgements

VHF/UHF Manual, GR Jessop, G6JP, (RSGB)
ARRL Handbook, (ARRL)

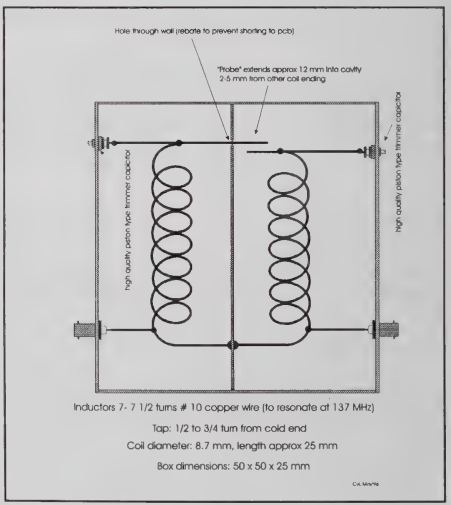
AN EASY TO BUILD HELICAL RESONATOR TO IMPROVE FRONT-END SELECTIVITY FOR APT RECEIVERS

Chris van Lint

History

With the boom in radio communications, the radio frequency spectrum is gradually becoming saturated. Many APT users report suffering from the effects of front-end overloading and spurious responses in their receivers. Although the problems caused by overloading can often be minimised or even eliminated by using wide dynamic range receiving techniques and/or discarding pre-amplifiers, spurious responses have to be dealt with before they reach the mixer. Only improved selectivity can solve this problem and the filtering circuitry employed in many but the very best (and most expensive) receivers are often inadequate to deal with these limitations. Having said that, readers should be aware that a wide dynamic range in the absence of adequate selective front-end filtering may not always be sufficient to keep out spurious responses in highly RF polluted areas!

Whenever APT enthusiasts complain about interference, very often the advice offered includes suggestions that they should use coaxial cavities, quarter-wave open circuit stubs or helical resonators. Coaxial cavities are quite effective, but they are bulky and require very careful mechanical construction. Practical construction details, especially for the APT band are scant and for most amateur weather watchers they are not a practical option. Quarter-wave open circuit stubs are also very effective, however they are difficult to adjust; relying on trial and error trimming of the stubs and should, ideally, be placed close to the aerial, which introduces potential mechanical problems resulting from exposure to the elements. In this article I propose to pursue the remaining, and possibly most elegant, alternative of using a helical resonator.


Hole through wall (rebate to prevent shorting to pcb)
"Probe" extends approx 12 mm into cavity
2-5 mm from other coil ending
high quality piston type trimmer capacitor
high quality piston type trimmer capacitor
Inductors 7- 7 1/2 turns # 10 copper wire (to resonate at 137 MHz)
Tap: 1/2 to 3/4 turn from cold end
Coil diameter: 8.7 mm, length approx 25 mm
Box dimensions: 50 x 50 x 25 mm

The helical resonator is small in size, hence robust and is very effective, having a rather sharp

pass-band. Again, in the past, the available literature has been rather general and construction details, especially for use in the 137-138MHz band, have been hard to find. Helical resonators are, in effect, shielded resonant sections of helically wound transmission lines with a high characteristic impedance and low axial propagation velocity. The signal in and out of the resonator may be coupled by either inductive, direct tapping or capacitive means or a combination of any of these. For the truly adventurous there is also the possibility of coupling by means of an iris or aperture in the shield wall between the two resonators. The adventure lies in the fact that both the location and size of the aperture has to be determined empirically! The description of the helical resonator to follow is specifically intended for use in the 137 to 138MHz band and is based on a design by Chuck, WA3MDH, who is rumoured to be able to solicit a satellite signal out of a shoe box. It is a double helical resonator with a tapped input, capacitive coupling from one resonator to the other by means of a 'probe' followed by a tapped output.

Construction is simple and requires no specialised equipment or parts, other than the 0.5-10pF trimmer capacitors, which need to be high quality piston types to ensure a high Q. With the trimmers and coil dimensions given, the resonators should tune from about 90MHz to 200MHz, making the device suitable for a variety of other receiving situations.

Construction

The box in which the resonators are housed is constructed from double-sided copper-clad printed circuit board. The box dimensions given in the drawing are nominal only as the final sizes depend on the thickness of your double sided board.

Start by cutting the double sided board. If your PC board is 2 mm thick, as in my case, you will need to cut the following:

2 pieces	48 x 52mm for the bottom and lid
2 pieces	26 x 52mm for the two sides which house the BNC connectors and trimmers
3 pieces	24 x 48mm for the two other sides and the dividing wall.

Once the pieces have been cut, wind your inductors, as shown in the drawing (direction does not matter) and place the ends of a coil on the 24 x 48mm side to be used as a divider, to determine where the coil should be positioned in order for it to be in the centre of the wall. Mark the position of the coil ends with a pencil. In my case I placed the two larger sides (26 x 52mm) and the dividing wall on top of each other and drilled two 1.5 - 2mm holes (depending on the thickness of the wire) through all three pieces where the two pencil marks were. Note that this will also leave a hole in the position on the dividing wall where each one of the inductors is

to be soldered to ground but I did not find this to be a problem.

The holes in the two larger sides should now be enlarged to accommodate the BNC connectors and trimmers, again following the detail shown in the drawing. Now solder the coils to the dividing wall. The hole through which the 'probe' coupling wire protrudes must be rebated on both sides to avoid shorting the probe to ground. The probe may be either an extension of the coil concerned or a piece of wire soldered to the appropriate trimmer capacitor. The dividing wall may now be soldered to the centre of the bottom of the box. Make sure that the wall is soldered parallel to the 52mm side of the box. The sides to which the trimmers and BNC connectors have been fitted may now be soldered in position and the coils are soldered to the connectors and trimmers as per the drawing. The tap on the inductors to be connected to the BNC connectors is about 0.5 to 0.75 turns from the "cold" end of the coil. The other end of the inductor is soldered directly to the respective trimmers. If you have left the 'hot' end of one coil long enough, you should be able to allow an 8 - 12mm length to protrude through the rebated holes into the other chamber. If not, a small length of wire may be soldered to the opposite trimmer to allow the 8 - 12mm to protrude.

Tuning is quite critical because of the narrow pass-band and the easiest way is to initially tune the inductors to 137.5MHz by means of an accurately calibrated GDO or better still a GDO loosely coupled to a frequency counter to ensure accurate frequency adjustment. Final adjustment is made with a signal generator or under dynamic conditions with an incoming satellite signal. The level of coupling of the probe to the coil is controlled by the distance between probe and the adjacent 'hot' end of the inductor. This distance should be between 2 - 5mm. The further away the probe is from the coil, the narrower the pass-band. The best position can only be determined by experimentation. Coupling too tightly will result in poor selectivity and coupling too loosely will reduce the signal level. If you do not have access to a GDO or Signal generator, the only way is to fiddle with the trimmers using an incoming signal. Because the filter is extremely sharp, this method should only be attempted on high elevation passes, when a strong signal is anticipated. If you wish you may now solder a lid on the box. Beware however! - If the lid is fitted after initial tuning, the unit will need to be tweaked up again.

WANTED: RX1 Built or unbuilt with RX1A 5ch upgrade. Tony Woodcock 01705 595900.

FOR SALE: Kenwood R-2000 receiver. FAX-1 (ICS), active antenna and SC-1500L printer + new printer ribbons. £400 ono. Phone JP Beardmore 01536 525056.

JVFAX AT 150, 200, 300 and 500 LINES PER MINUTE?

Graham Smith, G1JVZ, put this question to Eberhard Backeshoff, the author of JVFAX, to establish if it would be possible to transmit images from a computer to an unmodified, mechanical, fax printer (Muirhead K401).

Eberhard replied that it would be possible to modify the source code but he also suggested another way. You could set JVFAX to 180lpm, for example, and then change the 'Clock Timer Frequency' to 180/150 times the original clock timer frequency. This would result in a drum speed of 150lpm. With the same clock frequency setting, you can get 200lpm (set drum speed to 240lpm) and 300lpm (set to 360lpm). Only the 500lpm setting is unavailable.

DESCRIPTION OF COVER IMAGES

Front Cover
This composite channels 2 and 4 image from NOAA 14 on 10 July shows trails caused by ships to the southwest of Britain. See the article by CG Roberts for further details.

Inside Front Cover
Top: The Priroda module for Earth observation now docked to the Russian Mir complex. See Orbiting Update in this issue.
Bottom: Galileo's first colour image of Jupiter's moon Io. Imaged on 25 June from a distance of 2.24 million kilometres, this most volcanically active body in the solar system has undergone some dramatic changes since it was imaged by the Voyager spacecraft 17 years ago. The smallest features that can be discerned are about 23km across.

Inside Back Cover
Top: Chris van Lint's helical resonator. See his construction article in this issue.
Bottom: Part of the exhibition area at the POES conference in Annapolis. Smartech's new, flat HRPT antenna can be seen in the background (see page 13).

Back Cover
This fine image of western Turkey and the island of Cyprus was received and processed by Ferruccio Paglia. The image, from NOAA 12, ch 2 was timed at 0540UT on 11 June 1995.

MAKING MOVIES

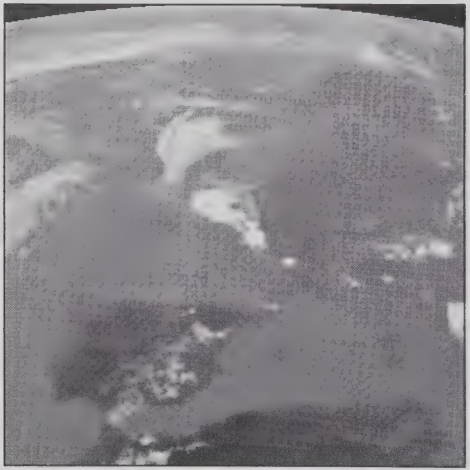
John Boyer G0WRX

Introduction

I recently acquired the ESA Meteosat collection number 3 CD-ROM entitled "Europe's Four Seasons" This double-disk CD-ROM package is well and truly stuffed to the gunwales with 32000 images totalling 14 Gigabytes of data! At least that's what the back cover says. I'll take their word as I've only got a 486 DX 50 and it takes ages for it to decompress pictures off the disk so I'm not going to do the lot to check. However, you can put it into a batch mode and walk away from the PC for a coffee break or even lunch. The nub of all this is that there is on the disk, half-hourly infrared and visible images which are ideal for animation. I have downloaded from Internet a demonstration copy of the Drastic MPEG Coder, which runs under Windows. This, used in conjunction with the Meteosat images on the CD-ROM, produces some rather tasty mpeg movies.

What is MPEG?

MPEG stands for Motion Picture Experts Group. If you think that MPEG sounds like JPEG you'd be right. See John Green's article in RIG 45 entitled 'Technology for the New Generation of NOAA Satellites' for more information on JPEG. MPEG uses JPEG techniques to encode some of its images. It also does some other very clever things such as motion prediction in successive frames. Imagine what happens when a camera pans from left to right. Most of the image hardly changes; it is just in a different position on the screen. So what MPEG does is send information saying something along the lines of 'move this bit this way'. A more technical way of putting it is that MPEG computes motion vectors between frames. MPEG also discards some of the colour information so that, all in all, you end up with a much smaller data rate than you would by coding each frame independently. I'm not



Developing thunderstorms like these over France make a good subject for a movie.

going to go into greater depth here but the help that comes with the Drastic MPEG Coder program has a very good explanation for those seeking further enlightenment.

What do I need to do?
There are three stages in creating your own MPEG movies; probably the most crucial of these is de-archiving pictures from the Meteosat CD-ROM. There is a setup program on the CD-ROM called, amazingly enough, setup.exe, which installs the decompression software. The program you need to use to de-archive images is Archivix. To decompress a set of images, click on the first image and drag the mouse pointer to the last image you want. The dates and times of your selected range appear in the boxes on the bottom left of the window. Then click on 'Add to List'. Be careful not to make the list too long unless you have a very fast machine. Then click on 'Decompress' and wait. When it is done you should have a selection of images that you can make into a movie.

The next stage is to make a MPEG movie. Use the file selection windows in Drastic MPEG Coder to locate the Meteosat images you have extracted from the CD-ROM. Either click on images individually and then on 'Add' or use 'select all'. When you have selected your source images, click on 'Encode'. This will give you a 'DME Encode Setup' window, and from here you can set lots of parameters but, for now, just do one little thing; set the 'CPU priority' to 'DME exclusive' as this speeds up the process considerably. Eventually, you will end up with a file called something like dme.mpv. Now use your favourite mpeg viewer and be impressed with your first mpeg creation.

Further thoughts.
I haven't fully explored the workings of either the Meteosat archive software or Drastic MPEG Coder. Both of these are capable of much greater feats than described in this article. The MPEG Coder defaults to a small image size of 352x240 pixels but the source images are much bigger. It is possible to make the Coder produce a full-size movie but the computational overheads soar. It is also possible to use it to generate AVI movies. This demo version of the 'Drastic MPEG Coder' is limited to 32 frames but there are programs for joining mpeg streams to create longer movies. Alternatively, you could straighten your halo and register the software.

Conclusion
The Meteosat CD-ROM number 3 provides a good source of images for the generation of MPEG movies. The Drastic MPEG Coder demonstration software is available on the Internet and probably from RIG's Shareware Corner and the RIG BBS by the time this edition of the journal hits the streets. The Meteosat CD-ROM is available from your RIG shop corner at a very reasonable price.

INTERPRETING WEATHER SATELLITE IMAGERY- PART 15

Peter Wakelin

The accompanying image of western Europe imaged by NOAA 14 in May was sent to me by Alan Jarvis who said, inter alia, "..and I was greatly struck by the very sharp line of clouds across the Pyrenees and the effect the southerly wind appears to be having over virtually the whole of western France". First impressions can be deceptive; in fact northerly winds were blowing over western France at the time! However, I believe I can understand why Alan thought they were southerly.

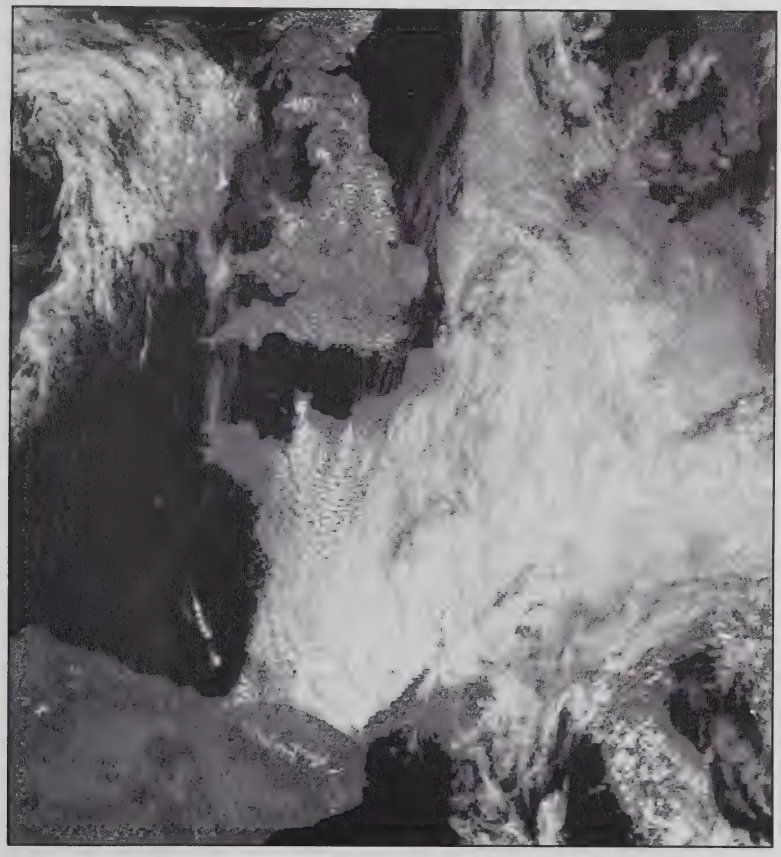
Way back in RIG 35, December 1993, I described the effect mountains can have on cloud appearance on satellite images. Air forced up over a mountain barrier will be cooled, often sufficiently for its water vapour content to become saturated and clouds to form. Further upward movement will result in rain (or snow) falling. Enforced upward movement of this nature may have enhanced the normal thermal effects and been a contributory factor in the recent tragic event in the eastern Pyrenees where flash floods devastated a campsite and killed dozens of people. Upon descending on the other side of the mountains, the air will be drier and warmer than before which often shows in satellite images as a cloud-free zone to the lee of the mountains. For a southerly flow to produce so much cloud over France after crossing the 2-3km high barrier it would need to be very moist over Spain and there is no indication of this.

The surface weather map in the *Daily Telegraph* showed high pressure to the west of Britain and France with a cool, northerly flow over both countries; light over Britain but stronger over France. Alan did not send me the infrared image but I am almost certain that it would indicate fairly warm tops to the convective cloud over France indicative of shallow convection typical of high pressure systems. Had the cloud formed in air that had crossed the Pyrenees, then it would be much higher and colder.

There is another tell-tale sign in the image that indicates a northerly flow. NOAA 14 passes northbound in early afternoon at the time of maximum heating and the temperature contrast between the sea (which does not undergo a significant diurnal temperature change) and land is greatest. The northern coastal regions of France are cloud-free because the surface has been cooled by the northerly winds off the sea and their is insufficient convection to carry the moisture in the air up to its condensation level. An interesting exception occurs on the Cherbourg peninsula where cloud has formed close to the sea. What has probably happened here is that a sea breeze component (blowing from cool sea to warmer land) from either side of the peninsula has met in the middle with upward forcing of the air. Air from one side of the peninsula came up against a barrier; not a mountain this time but air moving in another direction. When airstreams converge, whether on the large scale as in de-

pressions, or on the very small scale as here, uplift is inevitable and cloud may result.

My second image is from a totally different part of the planet yet shows some similar features. The equator crosses the centre of this image passing through the northern end of Lake Victoria, the dark cloud-free area near the centre. There is no hint of any large scale circulation on the image at all; it is just not possible near the equator

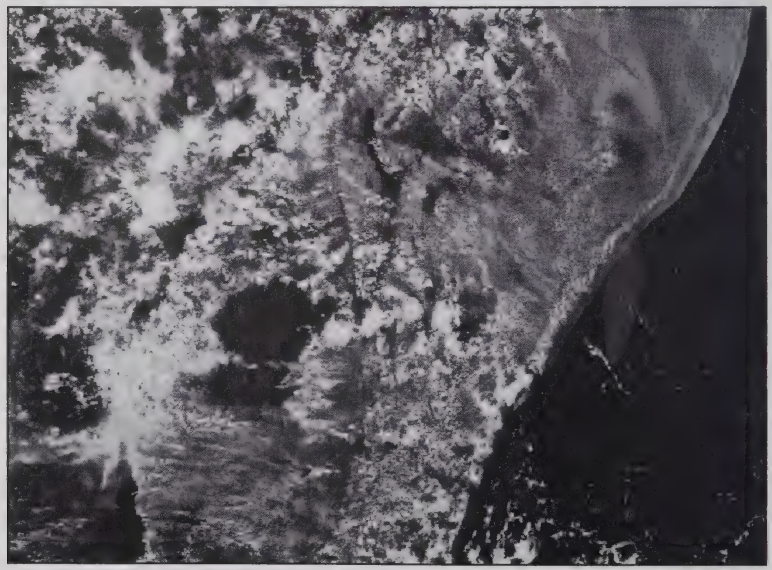


1330 UT 13 May 1996

where air moves directly from high to low pressure quickly ironing out any small pressure differences that do occur. With the exception of Somalia, in the northeast, most of the land area is covered by typical afternoon deep convective cloud but there are two areas where significant air movement can be deduced.

A noticeable line of cloud is evident parallel to the coast and a few tens of kilometres inland. The coastal strip is cloud-free as cool air moves in from the sea to replace air rising at the sea-breeze 'front'. Typically, this line of cumulus cloud forms on the coast in mid-morning and progresses inland as the land/sea temperature contrast increases and the onshore wind gains speed. Convective activity can be greatly enhanced if the land rises significantly near the coast as it does in the extreme south of Kenya and in northern Tanzania towards the bottom of this image.

Why is Lake Victoria virtually free of cloud? Sitting on the equator, is it not warm enough to support convection? True, the surface is warm but the surrounding land at 2pm local time is even warmer. Air rising over land is replaced by air from over the water - a 'lake breeze' but there is not an endless supply of air over the lake to replenish the rising air over the land. Nature abhors a vacuum so air has to descend



East Africa. Meteosat 4 1130 UT 14 March 1993.

over the water from higher levels to 'feed' the lake breeze. Now, as I have said numerous times before in this series, descending air warms and dries; hence no cloud over Lake Victoria. 12 hours later a different picture emerges. The land cools very rapidly after sunset (it is mostly more than 1200m above sea level) and its surface is soon cooler than the lake's. Hence, air flows inwards over the lake and has no choice but to go upwards, like the air over the Cherbourg peninsula but on a very much larger scale. Often, during the fine evenings after a day of showers, lakeside folk can sit and enjoy spectacular displays of lightning out over the lake.

The image here is part of the full resolution AV format from the high resoution data stream from Meteosat but both the 'lake effect' and the sea breeze front can be seen on the SDUS WEFAX images. The C6D frame at 1446UT often shows the sea breeze cloud extending 2,000km or more while the D6 IR images are best to monitor Lake Victoria's clouds.

RIG*sat* PROJECTS REPORT

Ray Godden & Bryan Taylor

Since the first RIG*sat* project was launched in March 1995 we have supplied over 650 printed circuit boards, 330 RX1, 120+ RX1A and 200+ IF1. This proves two things; that home construction is not as dead as often stated and that providing PCBs with comprehensive information for building and for the supply of parts greatly stimulates interest. It is clear from comments on the last survey form that, of the disciplines featured in the Journal, home brewing is one of the most popular. The current project under development is perhaps a little ambitious, a 1.7GHz downconverter - the Dcon1.

Committee members John Boyer and Sam Elsdon have joined the RIG*sat* Project Team and we have been offered substantial help with the supply of components for kits by RIG member Bob Barnes of Windrush Electronics, Cornwall. As many of you are aware there have been problems with our previous arrangement. The frequency at which the Dcon1 operates requires specialised components which will need some effort to locate at reasonable cost.

RX1

All our stocks of crystal filters and PCBs are now exhausted and unfortunately a number of orders had to be returned unfilled. No new problems have been reported - many RX1s have been built and are operating with good results. If you have bought an RX1 kit and do not expect to complete it contact RIG and we will put you in touch with another member who will be pleased to take it off your hands.

RX1A
Nothing to report.

IF1
The first batch of 100 PCBs has been sold and a further batch of 100 was recently received. The only significant problem known is the image slippage effect with some systems when JVFAX save modes are selected. This does not occur if the interface is used in JVFAX Parallel Port mode although in this mode the advantages of synchronism are lost; however, reports say that performance is otherwise excellent. Using a serial port via a converter is another approach but there is a possible patterning problem as JVFAX takes serial data as two 4bit nibbles: data could change during this process causing an alias. Graham Spray has found that setting up a Ramdrive cured the slippage problem. His message about this, with some other useful comments, is appended to this report. Contact has been made with Eberhard Backeshoff, DK8JV and efforts continue to find other solutions. **An unfortunate error has been found on the IF1 instruction sheet. Please do not telephone or fax the numbers stated. The CORRECT AREA CODE IS 01992 AND NOT 01922.**

GRAHAM SPRAY'S COMMENTS

JVFAX IF1 INTERFACE, picture slippage - possible cause.

When JVFAX is in the 'running' mode it periodically saves data to the computer's hard disk.

With (F3) save NOT set before 'running' the file has the name 'tmppic.gif'. This name is replaced by that given by the user if (F2) QuickSave is pressed when JVFAX returns to the 'waiting' state. Under (F3) AutoSave conditions the file name is JVFAX00n.GIF, with files numbered consecutively. In both cases data is written to the hard disk during picture decoding. On my 486/33 computer each access to the hard disk results in a slippage of the image, as the computer responds to the hard disk interrupt, which has priority over the interrupt used by the parallel port IRQ. One way to avoid this is to create a RAM disk using RAMDRIVE.SYS, and specifying 1Mbyte or more for the capacity. The Default Picture Directory needs to be renamed in the Configuration screen, the RAM disk is usually the next drive letter e.g. 'D:\charts'. Of course, one must remember to copy the files to the hard disk 'C:' before shutting down the computer, else they will be lost!

Incidentally the file name 'tmppic.gif' is created EVERY time JVFAX enters the 'running' state with F3 not pressed, so if the existing tmppic.gif is not saved by (F2) when 'waiting' then it is overwritten by a new file. This can happen if decoding is temporarily stopped during reception, i.e. if the 'squelch' decides to stop decoding and then restarts. This gives rise to the 'only part of the screen is saved' perception

so I always use the 'tone' method to avoid inadvertent stoppages.

My computer's parallel port, although configurable as bi-directional, does not work with JVFAX, as the IRQ is not accessible. I am using an additional I/O card that is bi-directional, but only IRQ7 is hard wired to the onboard integrated circuit, with IRQs 3, 4 and 5 selectable for the COM ports (serial) by links. So JVFAX is configured with the port address as 0278H (LPT2) and IRQ7 selected. Note that although 'parallel port' selection will work with this set-up, the picture cannot be synchronised and 'BidPrintPortPoll' does not work.

RIG IF1 interface - use of a RAM DISK.

The computer can store data to memory much faster than to a hard disk, thus picture 'slippage' during the image build-up is avoided. The size of such a RAM DISK needs to be around 1 MB or more for a typical satellite pass but the amount of memory allocated obviously depends on the total available in the computer. Typing MEM/C/P at the computer prompt displays the memory available, showing the size of Conventional, Extended and/or Expanded memory. Or switch on the printer and type MEM/C>PRN for a printout. If not enough memory is free check to see if SMARTDRV is in use. If it is then use DOS EDIT to amend the CONFIG.SYS file and place the word REM at the start of the line DEVICE=C:\DOS\SMARTDRV.SYS to disable its use, and then re-check with MEM/C/P.

To create a RAM DISK use DOS EDIT to add the following line to the CONFIG.SYS file: DEVICE = C:\DOS\RAMDRIVE.SYS 1024 /E

A figure of 1024 specifies a disk size of 1 MB, the /E creates the disk in Extended memory, ie above Conventional memory which holds the decoding program. If your computer has Expanded memory replace /E with /A. Assuming that the hard disk is allocated to drive C: then the RAM DISK will be allocated as D: Also check the line LASTDRIVE= in CONFIG.SYS to ensure that the entry is one letter more than the drives in use, eg LASTDRIVE=E

The area used for picture storage must also be re-defined in the decoding program, ie in JVFAX type C for the Configuration screen and in the field 'Default picture directory' amend the entry to read D:\CHARTS. Now quit the configuration screen by simultaneously pressing CONTROL and ENTER. Then press Q to quit the program. When the screen returns the normal prompt, type DIR/W D: and the directory name [CHARTS] should be displayed, confirming that the storage area is set.

Pictures may now be decoded and stored but note that this storage WILL BE LOST if the computer is switched off without transferring the image to the hard disk. To do this quit the decoding program and type the following line, where characters after the space define the hard disk storage area. COPY D:\CHARTS*.*

C:\JVFAX\CHARTS

A peculiarity of JVFAX is that when the computer is re-booted, or re-started, it loses the 'Default picture directory' entry using this RAM DISK method, so details need re-entering at the start of each session!

I hope this information proves to be of use - if anyone else has an alternative answer please respond.

WORLD WEATHER HIGHLIGHTS
May-July 1996

Two early season hurricanes, Abel and Boris struck the same part of the southern Pacific coastal regions of Mexico in the space of four days in late June. Most fatalaties occurred among fishing boat occupants.

Violent thunderstorms, often with tornadoes, are common over large parts of contiguous USA in summer and slow-moving storms can dump huge amounts of rain in a short period. One such storm hit Aurora, west of Chicago, on 17 July resulting in over 400mm of rain. On the following day, Oakfield in neighbouring Wisconsin was severely damaged by a tornado.

The annual Yangtze River flooding in China has been more widespread than usual and several typhoons have already affected the coastal provinces. Gloria passed very close to Luzon island in the Philippines before crossing the South China Sea. This image from GMS 5 shows typhoon Herb shortly after sunrise and a few hours before the image from Sich 1, which also appears in this issue, was received.

Moscow recorded a temperature of 36C on 11 July which is a new record for the month. In the UK, reliable records date further back than in almost all other countries yet records continue to be broken frequently. The highest surface pressures occur in winter but the record July UK pressure, which had stood for more than 80 years, was exceded this year when 1039.2 hPa (reduced to sea level) was recorded near Aberdeen.

The second week of July was unusually cold over many parts of interior South Africa with considerable snowfall in places and in parts of the east, where the winters are normally dry, up to 200mm of rain fell.

Typhoon Herb south of Japan 2100 UT 27 July 1996

AN AZIMUTH AND ELEVATION ROTATOR CONTROLLER FOR AUTOMATIC TRACKING

Sam Elsdon

Introduction

The unit described here arose from the desire to point a dish automatically for the reception of HRPT given that some of the required rotator equipment was already to hand - in my case, a suitable rotator for use in the azimuth plane complete with its controller. To complete the rotator system, I could either buy an R500 elevation rotator with its controller for around £250 or the complete R5400 azimuth/elevation system for around £520. The cheaper option is obviously attractive but the separate controllers have no computer interface whereas the R5400 controller does. I decided to take the cheaper option and design my own controller with computer interface.

Tracking systems compared

Before discussing the circuit, it may be as well to look at what can be used to control the system automatically.

Although there are several options, there are two notable contenders for deriving the pointing information and control signals. Autotrack from Timestep and Rotorinterface-2 from Martelec. From a functional point of view, the Timestep solution is the more elegant as it permits full 180° travel of the elevation rotator which is vital for overhead passes. Rotorinterface-2 uses only 90° of travel which means that as a satellite passes overhead, the azimuth rotator must turn through 180° very rapidly in order to follow the satellite down to the horizon. The rate of turn is so high that the azimuth rotator cannot cope and the signal is lost whilst the system catches up. Whether or not this is a problem depends on how desperate you are to receive overhead passes. In the UK, passes to the east yield the most interesting pictures (personal opinion) since they pass over continental Europe whereas overhead passes contain a lot of Atlantic!

The Timestep system also computes the satellite track in advance which allows it to avoid the azimuth mechanical end-stop on the rotator.

However, Timestep requires a dedicated computer for tracking whilst Rotorinterface-2 under the control of Instantrack will run other applications whilst tracking. I am told that another solution exists on the RIG BBS but I have not investigated this one. The choice is yours.

The circuit

A block diagram of the full system requirement is shown in Fig 1. The various signal legends can be followed from one diagram to the next. Under the control of suitable tracking software, the computer sends numerical information on antenna pointing angles to a tracking interface (TI) which converts this information into up/down, left/right movement signals which command the controller to activate the rotator motors.

The controller supplies the ac voltages to drive the motors and a dc voltage which is applied to an internal potentiometer in each rotator. The wiper of each pot returns a voltage which represents the position of the rotator output shaft. This voltage returns via the controller to the tracking device which uses it to sense the current pointing angle. The returned voltage also drives a pair of meters on the panel of the controller which are recalibrated to read angular position. Note that only rotators with internal position sensing pots are suitable for use with this unit.

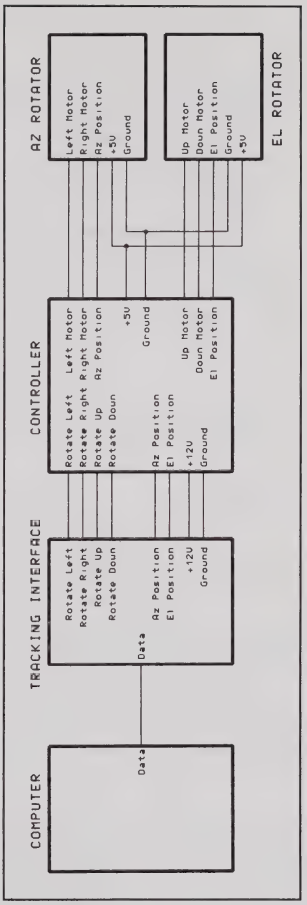


Fig 1. Block diagram of system.

The controller can either steer the antenna under computer control or be switched into manual mode to permit steering from the front panel. Switching to either mode excludes any control inputs from the other mode. When in manual mode, a LED on the panel flashes. Also, operating the left and right (or up and down) manual switches together causes the rotator to stop. Since significant ac voltages are present, opto-isolators in the controller protect the tracking interface in the event of a major failure.

Fig 2 shows a block diagram of the controller and is self-explanatory.

Fig 3 shows the PSU section. There is plenty of scope for creativity here. I originally

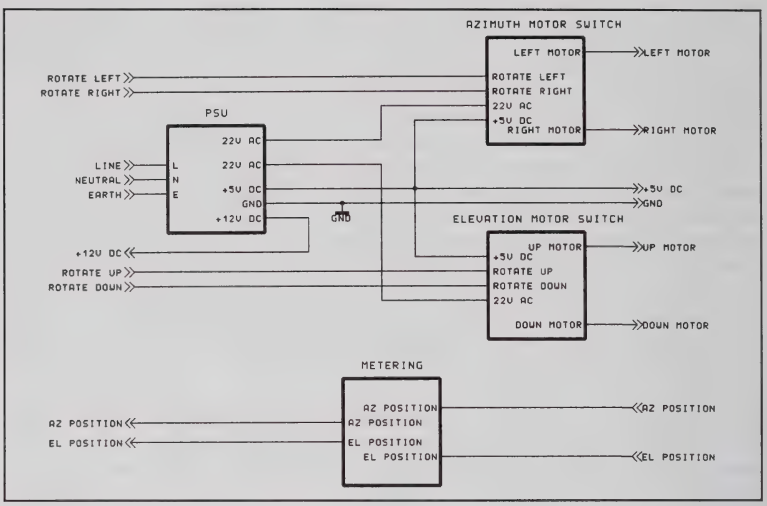


Fig 2. Block diagram of controller.

used the transformers from the controllers supplied with the rotators but found that they got very warm. This may have been due to proximity within the box but even changing the orientation and separation had little effect. I decided to use a grossly over-engineered solution of a single transformer (TX1) supplying 22V at 5A per winding. Needless to say, this becomes barely lukewarm. Being unsure about the degree of switching transients that would be generated by the motors, I opted for a second, small transformer, TX2, to operate the electronics. Maplin part numbers for the transformers are shown on the diagram. The DH71 toroid is quite expensive but a YK86 or a YK20 will probably do just as well.

Motor switching is shown in Fig 4. SW1a, b and U1a, b, c, d perform a changeover function between control signals from the TI and signals from the manual control switches SW2 and SW3. If desired, this could be performed with a 4 pole changeover switch but involves a lot of extra wiring to the panel. Note that U1c and U1d are used in the elevation switching - see below. The control signals from the TI must be low when active to operate this unit. D1 provides an indication that the unit is in manual control. Note that no series resistor is required with a flashing LED.

T1 and T2 activate the panel LEDs D2 and D3 and also light the opto-isolator LEDs. The active opt-isolator switches on the gate of triac Q1 or Q2 causing ac current to flow into the appropriate rotator winding. Note that C3 is 100µF non-polarised and

is probably best 'borrowed' from the controller supplied with each rotator. The rotator will not move without this capacitor fitted. The opto-isolators can be obtained from Maplin, part number QQ10.

The elevation switching diagram is not shown but is almost identical to the azimuth switching. The ROTATE LEFT/RIGHT signals and the LEFT/RIGHT manual switches now perform UP/DOWN functions. Note that SW1 is NOT repeated in the elevation switching. SW1a operates the control pins of all four switches in U1 by wiring pins 5, 6, 12 and 13 together. The connections for the other switches in U1 are: U1c between pins 8 and 9 and U1d between pins 10 and 11. SW1b connects to the same position on the elevation manual switches as it does on the azimuth manual switches SW2 and SW3. Pin 14 of U1 is connected to +5V and pin 7 is connected to 0V.

Fig 5 shows the metering circuit. P1 and P2 are the position sensing pots in the rotators. Once the unit is operational, R1 and R2 are adjusted so that the meters swing full scale to coincide with rotator movement. The meter scales can be removed and replaced with scales marked in degrees.

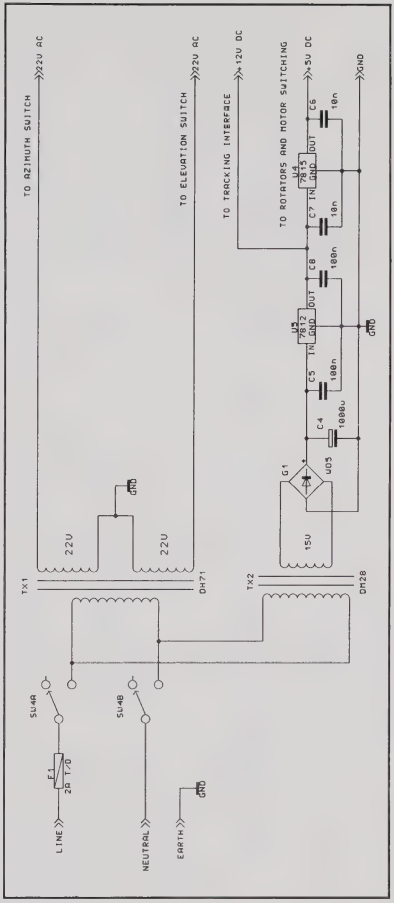


Fig 3. The PSU section.

Connections to the rotators vary from model to model. If you are using anything other than Yaesu or Kenpro rotators, check that the motor voltages generated by this unit are within limits. If eight-core rotator cable is available, this can be used as the sole control cable to the rotator pair. To reduce the connections to eight, the dc and ac returns share the ground connection. However, only attempt this with a

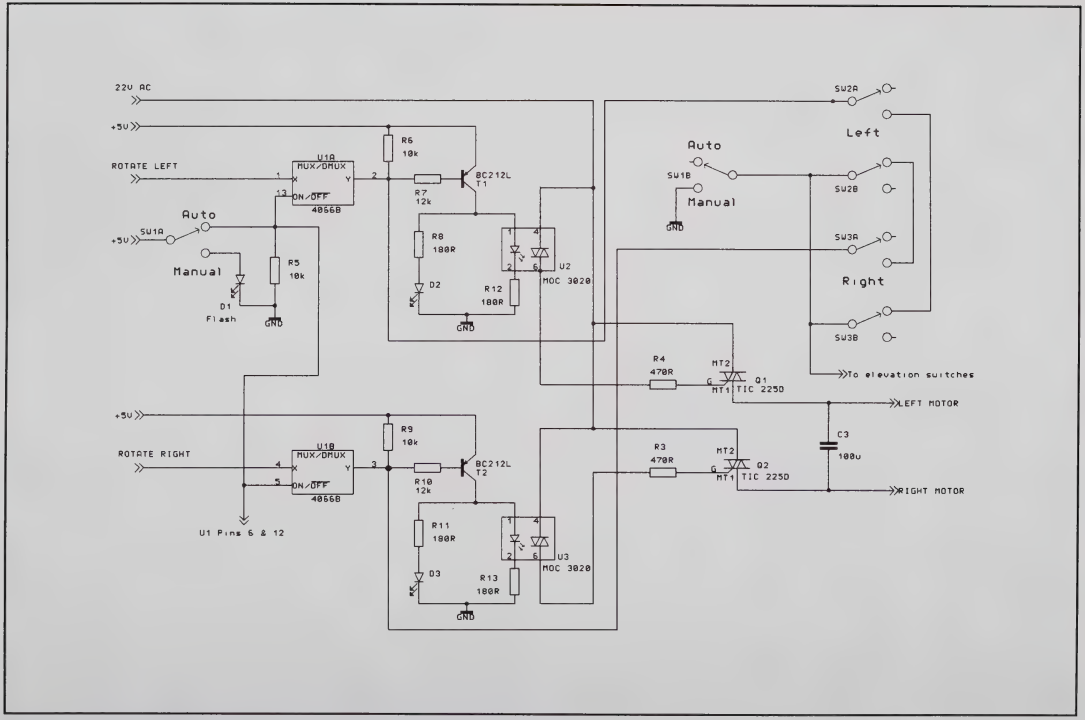


Fig 4. Motor switching circuit.

short run of hefty cable. In my installation, a connection strip is housed in a weather-proof junction box mounted next to the rotators. This is the point where the control cable is split in two for connection to each rotator. If in doubt, use a separate cable to each rotator and keep the ac and dc returns separate.

You should also check that the +12V supply to the TI is within limits for the model you choose.

The unit has been tested extensively and operates most satisfactorily with very little heat being generated due to the over-engineering mentioned earlier! Since I began this article, I have completed the HRPT receiver and its preliminary alignment. The auto-track system follows the satellite very accurately, maintaining a steady signal strength as the pass progresses.

My thanks to those members who showed so much interest in this system at the Chester conference and badgered me into writing this article.

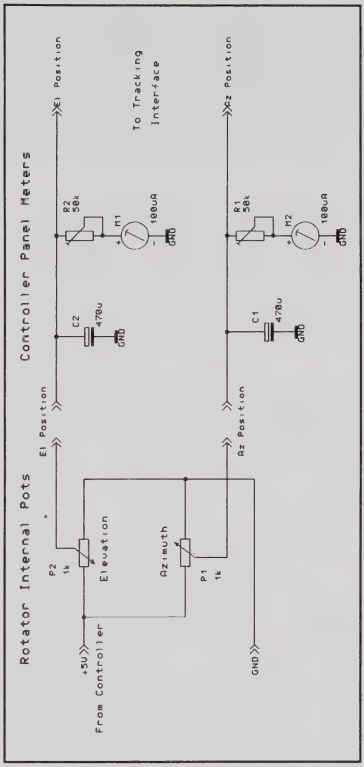


Fig 5. Metering circuit.

LINUX - A *FREE* OPERATING SYSTEM

Richard Drinkwater, MSCTE, G3ZIY

Many, if not most of you who receive images from the various satellites, rely on computers to collect and process them. From recent surveys, most of the computers used are PCs which are probably running the Microsoft Disk Operating System (DOS), or one of its variants, and some will have a Windows front end installed as well. DOS has been around in various forms for well over twenty years and to

maintain compatibility with older versions, the later versions are saddled with what is quite a compromised operating system. The work-rounds needed to enable backward compatibility slow the system down and if it wasn't for really fast computers, it is possible that DOS would have gone long ago. DOS is set to be replaced with a Windows operating system running a DOS emulator, instead of the other way around, which is, broadly speaking, the current arrangement.

Does a FREE (in both senses of the word) operating system, with built in multitasking, windows for graphic programs, multiple sessions executed simultaneously, fast speed, together with a DOS and a Windows emulator sound like good value? Too good to be true? That's what I thought until I tried it. It has all the above features and many, many more. You can customise it to do what *you* want it to do, instead of having to live with what the designer of your operating system thought you would like to do with it, by using scripts which you can edit in a basic text editor.

Linux is a 32 bit operating system designed for use on 80386 or higher PCs. It was originally conceived by Linus Torvalds, who wanted his own alternative to an earlier UNIX-like system called Minix. The Minix code was eventually incorporated into Linux.

The basic Linux operating system is command-line driven, much as DOS is. However, users of computers have come to expect more user-friendly ways to communicate with their computers and various types of window-driven systems have become popular. One of the Linux window systems available, called X windows, features multiple, moveable windows in which you run your Linux software. If you should run 'dosemu', the DOS emulator in one of the windows, you have a DOS operating system for your weather software and in other windows you could have any number of different software packages running concurrently, or even another 'dosemu' session for example. This is one of the powerful features of Linux; any number of sessions can be running simultaneously, until the computer runs out of memory, and every session could be accessing the same file, if such a need should arise. Linux does allow you to use a hard disk partition as a virtual memory block. In other words, you could set up your system to think it has, for example, 32MB of random access memory (RAM) on board! Very cheap but also very slow compared with the real thing.

Thousands of programmers around the world freely contribute Linux software. These folks are all keen computer users and many are professionals in the field. The general quality of the code is high and it is available from hundreds of Internet sites around the world. I've not personally come across any Linux viruses yet, although I have heard that there is one out there somewhere! For those of you familiar with Unix, Linux has most of the features resident in that operating system but tends to be more friendly.

I have my setup running an amateur radio packet station which is similar to a bulletin board service but accessed over the air waves instead of a landline. Compared with my previous DOS based system it is very stable (ie crashes are rare), is fast and lets me run other software whilst the packet radio software continues unabated. I have my system configured to support up to eight different sessions at the same time and I can switch amongst them at will by using the ALT key and function keys F1 to F8. As Linux has networking built in to its kernel, you could interconnect all the PCs in your house via their serial ports if you so wished!

A very easy way to get started is to acquire a copy of "LINUX Configuration and Installation" by Patrick Volkerding, Kevin Reichard and Eric F. Johnson, ISBN 1-55828-426-5. This book includes a CD-ROM disk that contains all the software needed to set up a Linux kernel on your computer's hard disk, or if you don't want to do that, a live system is included on the CD-ROM that you can try out. I have set up my system so that I can select either DOS or Linux by partitioning the hard disk and installing both operating systems. I followed the book's recommendations for basic Linux installation and partitioning and found it straight forward. The book assumes you know nothing about Linux but can handle basic DOS commands. After installation, it is a matter of selecting any other Linux software from the disk that you want on your system, such as X windows, and installing it using the supplied software.

Online HOWTO documents explain all aspects of using Linux and there is a vast online 'manual' on virtually every Linux command. If that doesn't get you going, there are dozens of FAQs (frequently asked questions) which have often come to my rescue! If you have access to the Internet, all the software is available online, together with the HOWTOs and FAQs. Linux is being continually developed by enthusiasts and more software is becoming available every day. To give you an idea of the scope of this product, there are Internet sites devoted entirely to Linux software (much of which will run on Unix machines). Because Linux is being continually updated, it may be difficult to get a completely compatible package of software. The book had all the necessary software and information together in one place, which was convenient. The included CD-ROM is a tried and tested product.

If you should ever get stuck, there is a great tradition of mutual assistance amongst Linux users. If you've read this far, perhaps this short introduction to Linux has whetted your appetite to try it out. It deserves to become more popular. If you should decide to try Linux out you need not be without your current operating system as Linux can emulate other systems if necessary. With the version on the CD-ROM, you don't even need to install it; just run it (slowly) through DOS.

VALVES?...WHAT ARE VALVES?
John Tuke

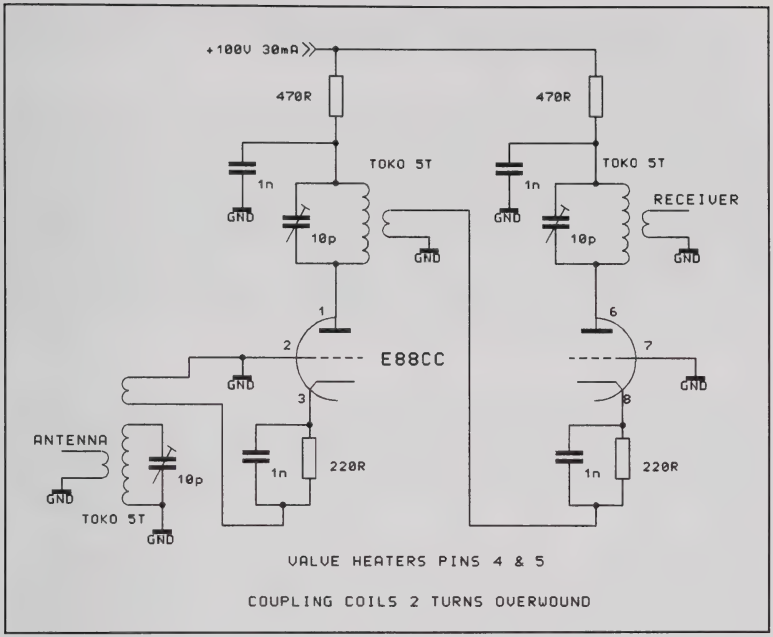
If you are an experimenter as well as a weather satellite enthusiast, then OK but if you are the latter only, then don't bother to read any further.

I live in a very pleasant part of Surrey - as far as beauty goes but the location is at the foot of a 300ft (90m) hill, surrounded by large trees and within a mile (1500m) or so of London's orbital motorway, the M25. On top of the hill are the pager transmitters and for every microvolt of NOAA or Meteor 3-5 that comes down my Lindenbladt aerial, I reckon there are enough pager volts to light a 100 watt lamp! A solution described in an earlier short note did alleviate the problem very considerably but, since then, either there are now more transmitters, or they are more powerful and, although the interference to NOAA is not too objectionable, Meteor 3-5 is a lost cause.

The receiving set-up has rung the changes between commercial and home-built receivers and pre-amplifiers with little success. If I left off the pre-amp, the range was very restricted owing to the location and as soon as the pre-amp was used, the trouble returned. Unfortunately, since retirement 16 years ago, I no longer have access to expensive test equipment, which I shamelessly used to borrow, so I was not able to make accurate measurements to determine where the trouble was occurring but I had an idea that the problem was over-loading of the pre-amp with subsequent intermodulation. I tried various FETs under different operating conditions without much success and then I thought of using a valve. Operated linearly, a valve will not show intermodulation products unless the input exceeds the grid bias and I felt that even the pagers would not reach this figure. In spite of doing my best to keep up with modern technology, I still have a soft spot for glass bottles with heaters, grids etc inside them and at least they can get red-hot without damage, which is more than you can say for FETs!

When I started to receive the weather satellite images in the mid-sixties, I used valves entirely and, not only did I have no problems with sensitivity for the polar-orbiters, but I received excellent signals from the geostationary ATS-3 on 137MHz. Fortunately, I still have a large box of valves and I unearthed a double triode specifically designed for VHF work; the E88CC. Two series grounded grid stages were made up, as shown in the diagram, and it was a success! There is now no interference at all on the NOAA satellite signals and only a very little on Meteor 3-5 at extreme range. It is a pleasure now to be able to receive Meteor 3-5, something I have been unable to do for the last couple of years or so.

Obtaining an E88CC may not be easy, although there are still some firms dealing in valves. I tried the very common 12AT7, 12AX7 and 12AU7 and they do all work but



with reduced gain, the AU seemed the best of the bunch. Of course, any two individual triodes suitable for VHF would be OK. Incidentally, the gain of the amplifier with the E88CC is slightly greater than that of the conventional FET job, so it is not a case of getting rid of pagers simply by reducing gain.

The coils are the small TOKO moulded type and the coupling coils are two turns of wire, 26g wound over the Tokos; the tuning capacitors the usual little foil trimmers. The only point to bear in mind is that the by-pass capacitors must have a suitable voltage rating. Anode voltage is 100 volts for the E88CC but the 12-7 range will take twice that. Where do you get HT volts these days? That's easy; two little heater transformers connected with the low-voltage windings back-to-back. Try it and see.

WANTED. Second hand & in gwo. We sat pc interface. Meteosat downconverter. Loop Yagi beam for Meteosat. 145Mhz five ele or more beam. Keith Artherton, Norfolk 01328 864068.

SHAREWARE CORNER

LES HAMILTON

It has become increasingly noticeable over the past two years how software development has increased in importance, while the appearance of really new innovative programs has become increasingly uncommon. On the satellite tracking front, STS Plus is under constant revision and is probably the leading graphical tracking program available. A number of members were impressed when shown its capabilities during the RIG Conference at Chester. In similar vein, Paintshop Pro, Graphics Workshop and Neopaint have gone from strength to strength and seem unchallenged as shareware graphics packages. Now, Graphics Workshop is available in a Windows-95 version too.

New items available this quarter include Power Viewer, a useful image viewer, and a debugged version of the ill-fated QPV, which has withdrawn early this year after developing problems. There is an interesting dynamic satellite tracker, REAL95, a utility for splitting large files over several floppy disks, and a small program which extracts 2-line elements from text files, and creates Amsat-type element sets.

POWER v 1.02

Power Viewer is a versatile DOS image viewer, claimed to be "the best DOS image viewer available, and much superior to QPEG, 2SHOW, GDS, VPIC and others". The truth of this is for you to decide, but it does support over 160 video cards, and displays images rapidly, especially JPGs. Other popular image formats accepted include GIF, BMP, PCX, TGA and TIF. The viewer itself is the program PV.EXE but my initial attempts to use it were frustrated by a beep and "mode set not successful" message. It proved necessary to run another file supplied with the package, UVCONFIG.EXE, first.

PV operates through pull-down menus, which are accessible to both cursor keys or mouse clicks. The software offers numerous features including colour balance and hue manipulation as well as brightness, contrast and gamma variation using a variety of key combinations. There is also a format conversion feature. The most interesting feature is PV's zoom, toggled by pressing the <Z> key while an image is displayed. For images larger than the VDU screen, smooth and seamless panning is achieved by rolling the mouse. This is the best image pan feature I have encountered - the complete image floats around beautifully in response to the mouse.

COPY2DKT v 1.11

This small program performs the handy function of splitting a large file over two (or more) floppy disks. In these days, when weather satellite images frequently exceed

the capacity of a single 1.44 Mb disk, it provides a simple method for mailing a single, large image.

QPV v 17c

When version 1.7a of QPV was offered last December, it soon became apparent that it ceased to function after several weeks, giving spurious virus messages and crashing. Version 1.7c appeared last January and appears to have overcome the problem. QPV is QPEG, but with a new name, reflecting the fact that it now accepts many more image formats than its predecessor. QPV now reads JPG, TGA, GIF, PCX, BMP, IFF, PBM, PNG and Photo-CD images. Furthemore, for images larger than the VDU screen, scrolling is much smoother than with the old QPEG. Always one of the fastest image viewers around, its JPEG decoding routines have been improved again, yielding speed increases of about 25% on a 486 computer and 45% on a Pentium.

REAL95

This is a DOS executable satellite tracker intended for use on an HP95LX (or equivalent) palmtop calculator, but it functions equally well on any PC. It uses a 40 by 16 character display to give the azimuth, elevation, and either range or subsatellite point of a number of satellites. A file, SAT-ID.DAT, must be edited with details of the satellites of interest, while their Kepler elements must be supplied in NASA 2-line form as a file called KEPS.DAT. The program is best run by calling the batch file SAT.BAT. Each row of the display shows a satellite name, its azimuth and elevation from your location and either the latitude/longitude of the satellite's subsatellite point, or, if the satellite is above the local horizon, the range in kilometers to the satellite. Data are incremented every second.

TESTD

This utility for correcting any drift in the PROsat II card's PLL circuitry from its nominal 2400Hz was reviewed in RIG 45, page 66.

MAKEDATA (MKDATA25)

This is a small program originating in Germany which decodes text files containing NASA 2-line elements into the more readable Amsat format.

UPGRADE NEWS

Graphics Workshop for Windows has been upgraded to version 1.1U. I also have the Windows-95 version, which I can supply if requested. The DOS image viewer SEA is now available as version 1.2. Although its version number remains unchanged, SATSPY has been modified to operate correctly with Windows-95.

SEPTEMBER ADDITIONS TO THE RIG PC SHAREWARE CATALOGUE

The following reviewed shareware is offered on this quarter's compilation disk.

Disk RIG46: POWER, CPY2D111, QPV, REAL95, TESTD, MKDATA25.

SHAREWARE TITLE CATALOGUE

Programs requiring Microsoft Windows are indicated by an asterix (*).

Disk A-04	*Earth Centred Universe v 2.0, Lunar Eclipse, Skyglobe v 3.6, Skyview, Solar Eclipse Predictor, Solar System Finder
Disk A-05	*Skymap v 2.1 - Planetarium that displays and prints star charts etc.
Disk C-02	Hamcomm v 3.0, JVFAX v 7.0, Packet Monitor, RTTY_FAX, Satcom
Disk F-01	CUTNOAA, DATtoPA2, JOIN-PIX, NOATIFF, CHOP, REJOIN, PCPLOT
Disk I-05	IMDISP v 7.9e, JPEG v 6A32, Neopaint V 3.2
Disk I-06	*Iphoto, *Lview Pro, *Photolab v 2.0
Disk I-07	*Photovision Pro v 1.1, *PDSWIN v 2.0
Disk T-05	*Logsat v 3.0, *WinOrbit v 2.8, *Satspy v 1.0
Disk T-06	PC Track v 3.11, STS Orbit Plus v 9615, Trackstar v 2.15
Disk T-07	AOS. AOSUS, Bird Dog v 3.0, NOAATime, Predict, Sortneng, Spredict, Weather Satellite Tracker v 4.7a
Disk T-08	Traksat v 3.10, *Wpredict v 2.63
Disk U-04	Adjust Clock, BBC Time, PC Configuration v 7.33, Geoclock v 7.1, MSF, *RIG Index v 1.23, Screen Thief v 1.58, FAXCNV01
Disk V-01	Compushow v 2.04, GIFEXE v 4.5, QPEG v 1.6E, SVGA v 1.12, VPIC v 6.2
Disk V-02	*GDS V 3.1g, PVE v 2.43, SEA v 1.2, *VUPRNT v 4.00

Disk W-01 Weathr50, Windchill, WX-60, Weather Wizard

Disk PSP *Paintshop Pro V 3.0 [2 discs for 32-bit version for Windows-95]

Disk GWS *Graphic Workshop V 1.1U

Disk Belmont *Belmont Image Technician (sophisticated image processing suite)

If you require more information about any of these shareware programs, please consult the program RIGSWCAT.EXE which appears on the majority of the shareware disks (space permitting). In addition to giving full details of each item, the program also features a search and find facility.

HOW TO OBTAIN COPIES OF THE RIG SHAREWARE LIBRARY DISKS

There is a despatch fee of £2 per order, which covers up to 6 disks (ie **not** £2 per disk). Send up to a maximum of 6 formatted 1.44 Mb MS-DOS 3.5" disks per request, to Les Hamilton, 8 Deeside Place, Aberdeen AB15 7PW, Scotland. Disks must be sent in a sturdy, re-sealable package such as a padded Jiffy bag (or a package within a package). Each separate request must be accompanied by:

i) a self-addressed adhesive label
ii) stamps for the return postage
iii) coins (or additional postage stamps) to the value of £2.

No fee is required from overseas members, but an exchange of shareware or interesting satellite images in exchange is always welcomed.

Any RIG Member coming across any new or updated versions of useful shareware is encouraged to send them to me at the above address. Should you experience any problems running any of the shareware from the RIG Library, please enquire by letter or e-mail, and I'll reply by return.

E-mail enquiries regarding shareware to: les@riglib.demon.co.uk.

WEATHERSAT INK

The problems encountered with the production of this magazine, which were reported in the June journal, have been overcome and subscribers received an issue during July. They say "we are running full speed ahead, with plans for some great future issues on our regular, timely schedule". For subscription details, see their advertisement near the back of this issue.

MEMBERS' LETTERS

Dear Mark,

There is a small point about the new RIG BBS which I thought I should mention which may make it easier for members to use. During a recent telephone conversation with a friend, it became apparent that he was unaware of the option to change his personal settings. He was experiencing problems downloading files with XMODEM setting and I suggested he use ZMODEM. This resolved his problem. There may be other members who are unaware that by selecting option 'Y' they can change any of the settings they entered during their initial log-on.

I would also recommend selecting AUTO DOWNLOADING which saves time and reduces the risk of errors and if they are able to select STREAMING as the transmit method, this will also help to speed up the transfer of data when uploading.

Finally, congratulations to you and Peter on an excellent effort with the new BBS. What an improvement on the old one which used to drive me crackers!

Kind Regards, Peter Finn, Morella, Wooden, Saundersfoot, SA69 9DY

[Editor's comment: There must be many thousands of possible combinations of modem, software and protocols in use so there will be some that will not work with a particular BBS. However, Mark and I are aware of very few difficulties and I do glance through the activity log from time to time to monitor for possible problems. It would seem that around half of those using the BBS already use ZMODEM. Yes, the system took some time to set up but the Wildcat software in use is very good and very robust. Just one person (who has confessed to using a modem not approved for connection to the public telephone network) has managed to crash the system (on two occasions) and thus deprive other members the use of it for several hours. His name, address and telephone number will be published if he does it again.]

Dear Peter

Over the last few months I have been reading about the shape of things to come in the APT world. The more I see the less I like it. First the good news; we are going to get high resolution pictures on 137Mhz. Then the bad; we won't be able to receive them because they'll be obliterated by pagers.

It seems that in the not too distant future, what you could once do with a handful of parts (audio AM detector) and an oscilloscope, will require something as expensive

and complex as a Pentium computer. It's APT, but not as we know it!

Simple, low-cost ground stations for NOAA APT could be a thing of the past. The present system can produce excellent pictures and has been refined over the years, although the resolution is a bit low but at least we can receive them, despite pager interference, if a high quality receiver system is used. What quality of receiver filtering is going to notch out a pager right inside the new broad band transmissions? If something isn't broken, why fix it?

Are we all going to have to fork out for an HRPT system and be there to take every pass by hand or programme a computer to do it? I don't think there's such a thing as a sense and lock system for small dishes. The 137MHz band could go the same way as the 27MHz radio controlled band went when CB-ers took over. Model fliers no longer use it because it's too dangerous. I wonder if the Americans have actually tested a prototype ground station in any country except the USA?

Perhaps we could get pager companies to switch off every time a satellite is due over the horizon. That idea is no dafter than putting pagers on this band in the first place. I hope my cynical and pessimistic view is proved unfounded over the next few years.

Graham Smith, G1JVZ, 3 Beech Hill Crescent, Mansfield, NG19 7EW

[Editor's comment: I hope that Graham's views are not widely shared among RIG members. Surely he does not really believe we should stick with the present twenty-year-old analogue APT system? Has he not compared the APT and HRPT images in this journal to see the advantages of the higher resolution digital images proposed for 137MHz?

Apparently, no "official" users of the 137MHz band in the UK have complained of the encroaching pagers and this may well be because the professionals no longer use 137MHz. For hobbyist users to expect to be able to pull perfect images out of the sky for almost no financial outlay is, in my opinion, quite unreasonable. However, as you will read elsewhere in this issue, the potential clash of pagers and 137.9125MHz in the UK is known to NOAA and EUMETSAT and this frequency may not now be used.

A new system of this complexity takes a long time to develop and METOP 1 is at least 5 years away. By then, computers will probably be cheaper, in real terms, than the simple frame-store was in its heyday in the mid-1980s. Even if the pager clash is not resolved, I am sure many members will regard the problem as a challenge and a solution will be found, preferably without resorting to high gain, narrow beamwidth, directional antennas.] ⊕

ORBITING UPDATE

ALL THE LATEST NEWS

POLAR ORBITING SATELLITES

Some systems on the nearly-twelve-year-old NOAA 9 are still functioning but no imaging has been possible for more than a year now. The Solar Backscatter Ultraviolet radiometer is still usable for ozone measurements.

Visible imagery on NOAA 10's HRPT frequency has been good but will soon lack illumination at north temperate latitudes. The IR images are poor following damage to the sensors by sunlight last year. The APT transmitter remains off.

NOAA 12 continues to function as the southbound morning craft and NOAA 14 is the operational afternoon northbound satellite. Both have experienced some failures but the imagers are in good shape.

NOAA K, which is destined to become NOAA 15 when in orbit, is now expected to be launched early next year.

METEOR 3-5 has now been in orbit for 5 years. It stopped transmitting on 137.85MHz on 2 August but the fortnightly FANAS prediction message issued on 6 August gave no hint of a problem and indicated that it would continue to transmit until METEOR 2-21 took over on 21 August. Its visual appearance seemed normal on 3 August as seen from Ascot with no brightness variations which might indicate stabilisation problems. Transmissions resumed on 7 August. Geoff Perry reported that he heard a distinct command-on at approximately 0848UT when the spacecraft was southbound over Western Europe.

METEOR 3-5's passes precessed through local noon close to the summer solstice this year for northern observers so ground illumination was high for many weeks. Numerous members have reported very good imagery, especially from Arctic latitudes.

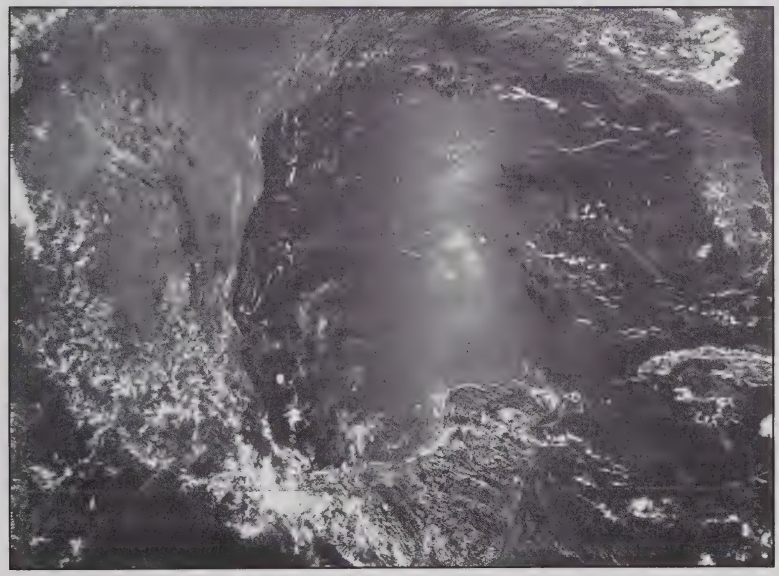
METEOR 2-21 took over from 3-5 for about two weeks from 14 May and is expected to do so again in late August when the southbound passes of METEOR 3-5 precess into the dawn.

It was reported at the 24th meeting of the Co-ordination Group for Meteorological Satellites (CGMS XXIV) held in Lauenen, Switzerland that METEOR 3-6 failed in 1995. It was also reported that the cost-saving option mentioned in RIG 44 is to be

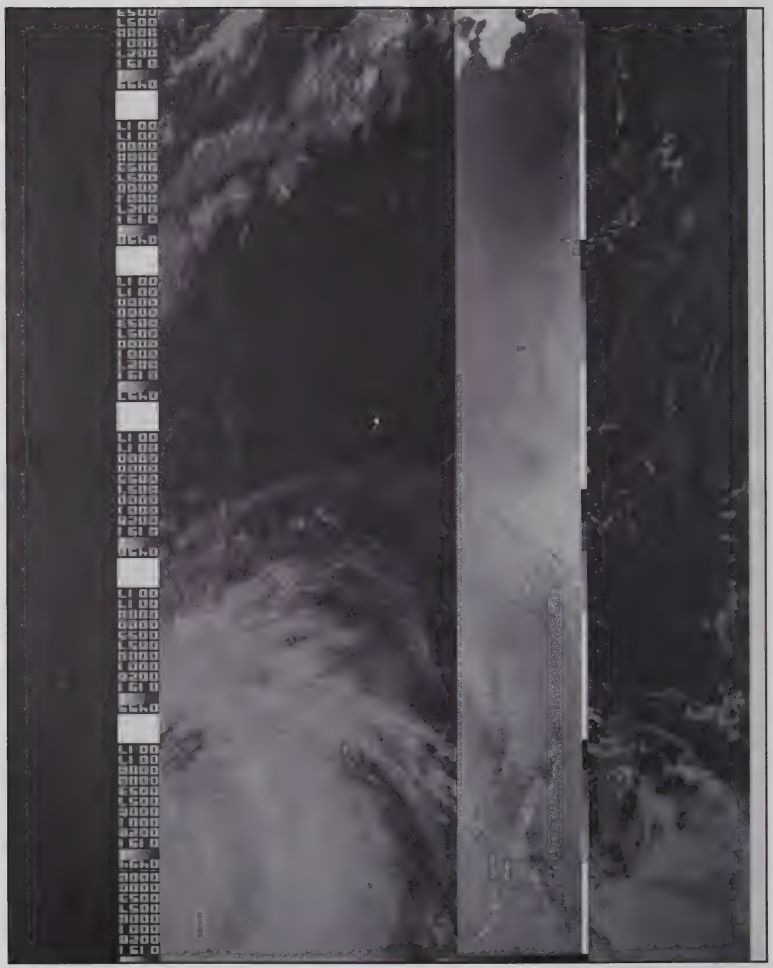
implemented. That is, rather than launch the remaining Meteor 3, meteorological instruments will be added to the RESURS 01-4 spacecraft to be launched into a lower, 835km orbit in 1997. The first of the upgraded Meteors, METEOR 3M-1 is now projected for launch in 1998.

OKEAN 4 and SICH 1 continue to generate much interest among our members. Alex Ivanov's transmission schedule for these two almost identical craft is by far the most popular down-loaded file on the RIG BBS. On 24 July there was an unscheduled transmission of a recorded image showing typhoon Gloria close to Luzon island. Four days later a fine image of typhoon Herb to the south of Japan was dumped over Europe.

On 15 June John Murray received an image on 137.4MHz which did not emanate from either Okean 4 or Sich 1. Geoff Perry deduced that COSMOS 1602, an early Okean-type spacecraft, was responsible. The cloud pattern observed was consistent with that seen on Meteosat 5 imagery at the location of Cosmos 1602 over northern Russia at the time. No further transmissions have been reported. Another similar craft, COSMOS 1766, also exhibited a brief period of activity in February 1995 as



Gulf of Mexico. Meteor 3-5 21 Jul 1996. Arthur Holmes.



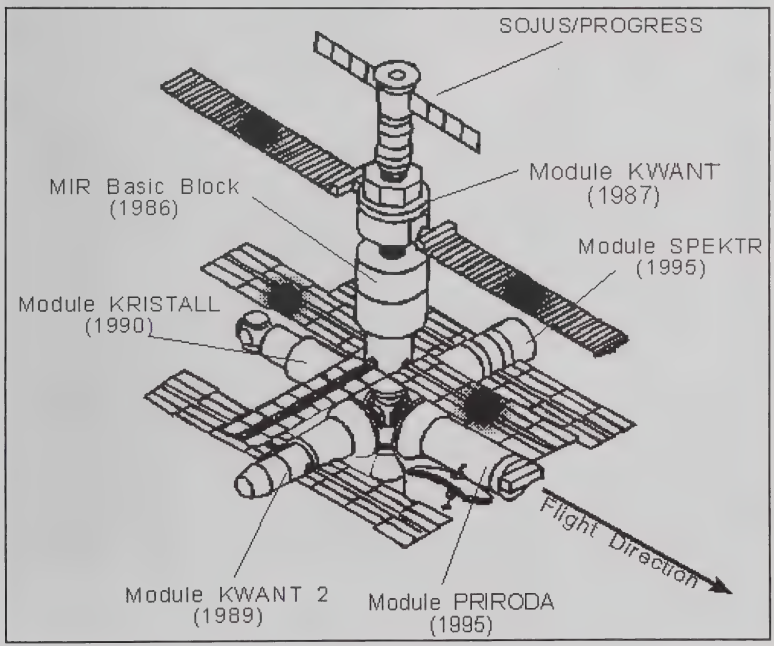
Typhoon Herb south of Japan. Sich 1 imaged at 0513 UT 28 July 1996. Received in UK 8 hours 18 minutes later. Note the displacement northwards of the radar image at centre in relation to the visible image.

was reported in RIG 40 (p 65).

The next Chinese polar-orbiting weather satellite, Feng Yun 1C, is now due for launch in 1998 to a sun-synchronous 870km orbit. There will be no APT and the digital CHRPT system is not compatible with existing HRPT systems.

The PRIRODA (Russian for Nature) module was launched on 23 April and docked with the Russian Space Station MIR at 1343UT on 26 April from where it is making a wide range of Earth observations. Although no APT-type imagery is transmitted, we hope to print an image or two during the planned two year life of the module. PRIRODA incorporates the German MOMS-2P scanner which has a ground resolution of 5m and a synthetic aperture radar, TRAVERS, which can operate at both 9 and 23cm and numerous other instruments.

The Indian Space Research Organisation also launched a new Earth observation



Location of PRIRODA module on MIR.

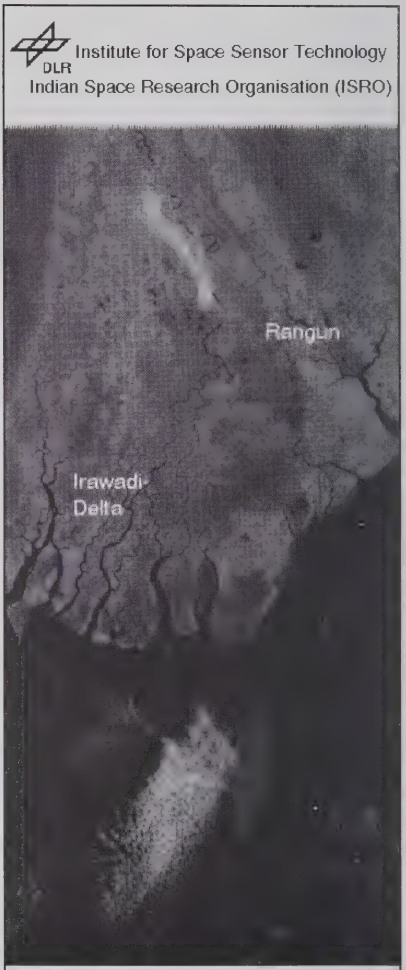
satellite earlier this year. IRS-P3 went into a sun-synchronous 830km orbit from Sriharikota on 21 March and the first images were received two days later. Compare the image of the Irrawaddy delta, which is reproduced here, with the one from NOAA 14 in the last journal (page 102).

By the time this journal is published, yet another new Earth observation satellite should be in orbit. The huge Advanced Earth Observing Satellite (ADEOS) is due for launch in mid-August on an H-II launch vehicle from the Tanegashima Space Center in Japan. Its 3m x 24m solar array can generate 4.5kW of energy to power a wide range of instrumentation.

GEOSTATIONARY SATELLITES

METEOSAT 5 is the prime mission satellite at the nominal position of 0 degrees longitude. The orbit inclination is 0.647degrees and increasing. The present hydrazine reserve is estimated to be 7.3kg which will allow nominal orbit and attitude control until April 1997.

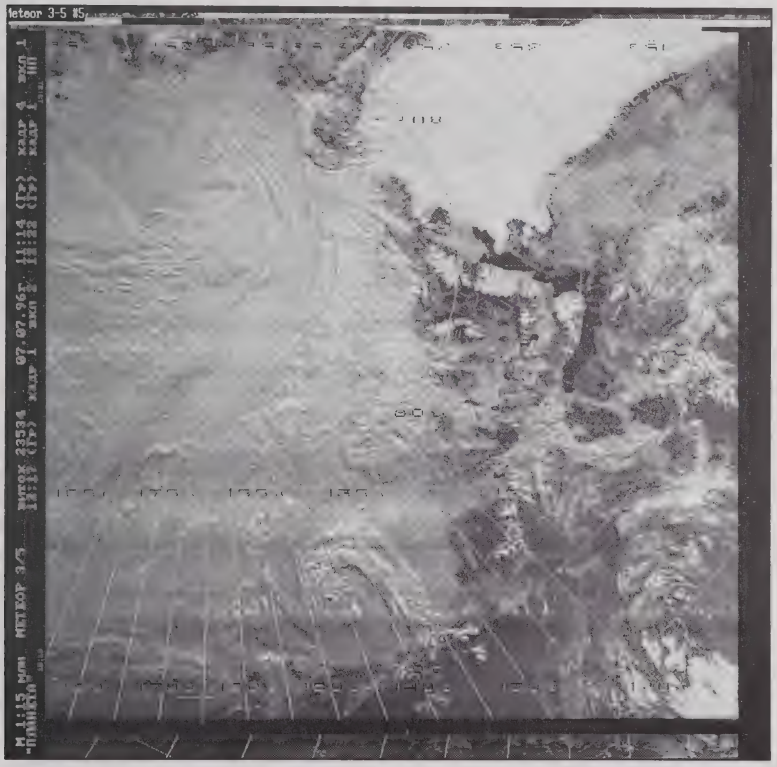
During last winter, contamination of Meteosat 5 resulted in loss of thermal regulation for about two weeks, so decontamination of the spacecraft (cooler and cold optics) has been scheduled for week 34. Decontamination involves heating the cold components to vaporise the contaminants. WV and IR imaging cannot be performed during the decontamination period so from slot 18 (0900UTC) on



First Image from MOS-IRS, 23.03.1996
Irawadi-Delta (Myanmar/Birma)
SWIR-Channel MOS-C

19 August, until slot 17 (0830UTC) on 23 August, the operational mission will be performed in a 'split-mission' mode. All imaging will be performed by the stand-by spacecraft, Meteosat 6, at 10 degrees west. The images will be rectified to the nominal sub-satellite point of 0 degrees and then disseminated via Meteosat 5 so there will be no requirement to realign antennas. This will be the first time that Meteosat 6 images become available to the user community for any length of time.

METEOSAT 6 remains the standby spacecraft close to 10W. The orbit inclination is 0.134 degrees and increasing. The present hydrazine reserve is estimated to be 29.7kg which will allow normal orbit and attitude control until mid-2001.



Meteor image received from GOMS by Chris van Lint in HongKong.

The major part of the image anomaly correction software to compensate for the radiometric anomaly of the WV and IR images has been integrated and validated. This will allow for its operational application during the 'split-mission' in week 34 of 1996. Some addtional fine tuning is nevertheless still required to fully ensure the operational useage of Meteosat 6 for permanent mission support.

METEOSAT 7 (or MTP-1) is the next of the current series of Meteosat satellites. The launch date for Meteosat 7 is now expected to be 4 July 1997. At EUMETSAT, in Darmstadt, the system validation tests for Meteosat 7 are underway.

Meteosat high resolution imagery relayed to the USA via DOMSAT is now encrypted with the exception of a three-hourly clear slot.

There is nothing to report on GOES 8 at 75W, GOES 9 at 135W or GMS 5 at 140E.

GOMS 1 continues to be disappointing in terms of eastern hemisphere imaging. It was reportedly operational from 1 June and although imagery from other spacecraft, as well as meteorological charts, have been disseminated, images from GOMS' own instruments have been very rare. There is a problem with the L-band raw data downlink transmitter on the spacecraft so data may have to come down via the X-band system.

Following the destruction of China's first geostationary weather satellite, FENG YUN 2A, during testing in April 1994, its replacement, FY-2B, is nearing launch readiness. *Space News,* (July 8-14, p 3) reported that launch would take place on a Long March 3 rocket this autumn. *[Latest: 12 December - from Mike Kenny, BoM, Melbourne]*

All geostationary satellites will experience a short time each day without sunlight as the Earth passes between the satellite and the sun for a period of at least three weeks on each side of the equinox on 22 September. Imaging is suspended during the eclipse period when only battery power is available.

Acknowledgements: I am grateful to the following for their contributions to this report: Volker Gaertner, EUMETSAT; Dr D Hinsman, WMO; Mike Kenny, Bureau of Meteorology, Melbourne; Geoff Perry MBE and Chris van Lint. ⊕

FOR SALE: Turnstile crossed dipoles antenna with Martelec VHF preamp boxed and weatherproof. Never been erected. As New. £35 inc p+p. WANTED: Satellite receiver for Meteosat 137.50MHz Cirkit or similar, will convert, anything considered. M Taylor. Mansfield Tel 01623 640605.

KEPLER ELEMENTS

NOAA 10
1 16969U 86073A 96225.86414942 .00000032 7349
2 16969 98.5264 221.3126 0012526 184.7157 175.3908 14.24998482514670

NOAA 12
1 21263U 91032A 96225.75591116 .00000068 0433
2 21263 98.5536 243.2385 0013925 108.3007 251.9690 14.22647282272504

NOAA 14
1 23455U 94089A 96225.84750294 .00000015 7060
2 23455 98.9491 171.1629 0010607 080.1445 280.0926 14.11602985083447

METEOR 2-21
1 22782U 93055A 96226.20982866 .00000054 5043
2 22782 82.5498 301.9499 0021962 174.2649 185.8766 13.83058564149016

METEOR 3-5
1 22969U 94003A 96223.85455273 .00000051 2752
2 22969 82.5563 221.9183 0016383 097.7583 262.5372 13.16737495122249

OKEAN 4
1 22317U 94066A 96225.92087741 .00000187 1748
2 22317 82.5418 006.8286 0024493 257.2844 102.5629 14.74033888098895

SICH 1
1 23657U 95046A 96226.17401068 .00000193 1007
2 23657 82.5341 148.1123 0026039 223.3677 136.5485 14.73487471051226

Frequencies: NOAA 14 137.62MHz, NOAAs 10/12 137.50MHz
METEORs 137.30, 137.40 or 137.85MHz
OKEAN 4, SICH 1 137.40MHz

Explanation of elements format above:

Line 1: NORAD catalogue number, International designation, Epoch, Decay rate (NDOT/2), Bulletin number (thousands omitted), Checksum (1 digit).

Line 2: NORAD catalogue number, Inclination, Right Ascension, Eccentricity (decimal point omitted), Argument of perigee, Mean Anomaly, Mean motion (8 decimal places), Rev. number, Checksum (1 digit). ⊕

RIG GIF LIBRARY

PETER WAKELIN

Ferruccio Paglia has sent a number of superb HRPT images received in northern Italy, almost all of which depict scenes close to, or beyond, the limit of reception from the UK. The image files are large so there are only 3 or 4 on a disk but the quality compensates for the quantity. The monochrome one here shows the Canary Islands and parts of Western Sahara and Morocco as seen by NOAA 14, ch 2 at 1424UT on 8 June 1995. another, in colour, is reproduced on the back cover. Ferruccio's images are on disks 149, 150 and 151.

The full list of available disks appeared in the March journal. The additions since then are as follows:

148	GOES9/HRPT from Australia (7 images)	Jim Whittaker
149	HRPT R. Nile, Cyprus, Azores (4)	Ferruccio Paglia
150	HRPT R. Volga, Egypt, Iraq (3)	Ferruccio Paglia
151	Azores, Canaries and Cyprus (3)	Ferruccio Paglia

Canary Islands NOAA 14 Ch2 1424 UT 8 June 1995.

HERE'S HOW TO OBTAIN DISKS

The cost is £2 for the first disk plus one pound for each additional disk with no limit to the number ordered. RIG provides disks, packaging and postage. For small orders, UK members may prefer to send postage stamps rather than write cheques for small amounts.

UK members: Cheque or postal order made payable to Remote Imaging Group and sent to Peter Wakelin, 1 Charters Road, ASCOT, Berkshire, SL5 9QF. There is no credit card service for members in the UK.

Other members: Bank draft (in Sterling and drawn on a London-based bank) or Eurocheque made payable to Remote Imaging Group and sent to Peter Wakelin at the address above. Overseas members may prefer to pay by credit card (subject to a 3% surcharge). Credit card orders should also be sent to Peter Wakelin either by post or fax (+44 1344 26028). ⊕

HUBBLE'S 100,000TH EXPOSURE

The Hubble Space Telescope reached a milestone several years earlier than scientists expected when it snapped its 100,000th exposure on 22 June. This achievement is largely attributed to better management of telescope observing time. A second on-board tape recorder is now used to store images and improved software has also helped increase efficiency.

More than 25% of exposures were spent on probing galaxies and clusters of galaxies and another 25% on stars and star clusters. It has imaged about 10,000 different objects. Jupiter and Saturn top Hubble's favourite target list. ⊕

SATELLITE DAMAGED IN COLLISION WITH SPACE DEBRIS

Aviation Week and Space Technology, 12 August, reported that a French military satellite, Cerise, was struck by a fragment of the Ariane rocket which launched SPOT 1 in 1986. The collision occurred in late July.

Anomalous behaviour of satellites in the past has sometimes been attributed to collisions with natural or other man-made objects but this is probably the first time that the identity of the object causing the damage has been ascertained. Modern radars and computers now enable fragments just a few centimetres across to be accurately tracked. The recent explosion of a relatively small Pegasus rocket resulted in several hundred additional pieces being catalogued. ⊕

RIG HELPLINES

General enquiries Meteosat information, NOAA information, Complaints about RIG-supplied equipment.	John Tellick	0181 390 3315

A copy of the Group's rules can also be obtained from John Tellick

Russian and Chinese satellite information	Peter Wakelin	01344 23200
HRPT	Peter Wakelin	01344 23200
PDUS	James Brown	01656 782632 *(not available on Sundays)*
Antennas and computing	John Boyer	01293 776862 *(7.00pm-9.00pm not Tuesdays or Wednesdays)*

Schools/educational co-ordinator		John Tellick	0181 390 3315
Schools/educational enquiries	John Murray	Torquay	01803 386252
	Frank Bell	Godalming	01483 416897
	Tom Walter	Reading	0118 9871330
	Bob Coombes	Haslemere	01428 642930
	John Din	Bristol	01454 773387
	Alan Wright	Norwich	01603 713449
	Rob Bales	Merseyside	0151 3439300

Microcomputer specialists:

PC and printer problems	Mark Pepper	01344 777730 *(8.00pm-9.00pm)*
Commodore Amiga	Chris Pretty	01420 82752
Archimedes	Tom Walter	0118 9871330

NOTE: We are grateful to the above members for offering their services to the Helpline. Please do not abuse the service by ringing them for queries other than those listed against their names.

Most of the helpline numbers listed under Schools/educational enquiries are situated in the south of England. John Tellick (address on page 2) would be pleased to hear from members in the educational field in other areas who would be willing to give help and advice.

RIG Subscription - New member

If you would like to join RIG and receive this Journal, complete this form (or copy) and send it to:-

RIG-SUB, PO Box 142, RICKMANSWORTH, Herts, WD3 4RQ, England.

The subscription rates for 1996 are: UK - **£10**, Europe outside UK - **£12**, Outside Europe - **£14**.

Please note that subscriptions are renewable each January 1st - whenever you join you will receive all issues for the current year.

If you would like to have back issues see 'Shop Corner'.

TOTAL AMOUNT:£ _____ Cheques payable to 'RIG' (no foreign currency please)

- or payment by credit card no. -

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Expiry date - ☐☐☐☐

Signature _____

Name _____ Call sign _____

Address _____

_____

_____

Post code _____ Country _____

Tel. _____ FAX _____

Email _____

Are you willing to have your name/address made known to other members?
YES/NO (Delete as applicable)

Are you receiving :-
Polar orbiting weather satellites _____ Geostationary weather satellites _____

DECLARATION: I do NOT object to the Remote Imaging Group holding my membership details on a computer.

Signed _____ Date _____

RIG SHOP CORNER

ALL PRODUCTS ARE FOR SALE TO RIG MEMBERS ONLY, FOR THEIR OWN PERSONAL USE AND NOT FOR SELLING-ON.
IN THE EVENT OF PROBLEMS WITH EQUIPMENT PURCHASED FROM RIG PLEASE CONTACT RIG IN THE FIRST INSTANCE AND NOT THE MANUFACTURER.

All prices shown include post and packing except where marked

Receiving / Decoding Equipment	**UK/EC Price**	**Overseas Price**
RIG*sat*-RX1 two-channel 137MHz self-build receiver.		
PCB, crystal IF filter and FETs	No longer available	
PCB and FETs only	No longer available	
RIG *sat*-RX1A 5-channel upgrade PCB	£4.00	£4.00
RIG *sat*-IF1	£4.50	£5.00
RIG DARTCOM Meteosat Downconverter. Assembled and tested module in tin plate box	£155.00	£132.00
Complete, assembled and mounted in weather-proof box.	£190.00	£162.00
RIG DARTCOM VHF Scanning Receiver. Assembled and tested module with LED channel number display.	£135.00	£115.00
As above but with LCD frequency read-out instead of LED channel number display. *Both the above items are modules and require a box, together with several components, switches, etc.*	£179.00	£152.00
RIG VHF Preamp. Includes a bandpass filter and is ideal for mast-head mounting. Assembled/tested module; needs boxing.	£18.00	£16.00
RIG 1695MHz Low Noise Amplifier kit. *Experienced constructors only.*	£29.00	£25.00
Martelec JVFAX Interface Unit	£78.00	£70.00

Connecting lead £5 extra (specify whether 25 or 9-pin required)

Antenna systems	UK Price
RIG CROSSED DIPOLES A Turnstile type design, in kit form	£26.00
RIG/TH2 47-element YCV loop Yagi (1.7GHz)	£85.00
JAYBEAM 5X-Y 2m 5 element crossed Yagi, in kit form	£55.00

DISHES, FEEDS and BACKING PLATES not available by mail order. Contact Henry Neale. Tel:01945 440353

Crossed dipoles and the YCV loop Yagi can be dispatched overseas. Postage extra. Details on request from Peter Wakelin.

RIG Binders

UK Price £4.00 each, EC/European Price £4.50, Outside Europe Price £5.00.

CD-ROMS	UK Price	EC Price	Other Price
Meteosat No. 2, Weather in Motion	No longer available		
Meteosat No. 3, Europe's Four Seasons (2 disks)	£12.50	£13.50	£15.00

Back Issues of RIG Journals

		UK Price	EC/Europe Price	Outside Europe Price
RIG 8-11	1987	£5.00	£6.00	£7.00
RIG 12-15	1988	£5.00	£6.00	£7.00
RIG 16-19	1989	£5.00	£6.00	£7.00
RIG 20-23	1990	£6.00	£7.00	£8.00
RIG 24-27	1991	£6.00	£7.00	£8.00
RIG 28-31	1992	£6.00	£7.00	£8.00
RIG 32-35	1993	£6.00	£7.00	£8.00
RIG 36-39	1994	£6.00	£7.00	£8.00
RIG 40-43	1995	£6.00	£7.00	£8.00

Note: Prices quoted are for a set of four, including Post and Packing.

RIG 1-7 are currently out of print. Owing to depletion of some issues, photocopies may be supplied. Individual issues are no longer available (hardship cases excepted).

Ordering Information

All items are available from the Editor, Peter Wakelin (address on page 2) and include return by UK 1st class mail (except antennas and Journals). Items to non-UK addresses sent via airmail.

UK VAT is now applicable on sales to the following EC countries - France, Germany, Belgium, Portugal, Spain, Republic of Ireland, Austria, Sweden, Denmark, Italy, Luxembourg, Netherlands, United Kingdom (including Isle of Man). Members in these countries should use UK/EC price when ordering. EC members who are registered for VAT must forward their VAT registration No. to the Treasurer to enable them to receive VAT exempt goods.

As UK/EC prices now include VAT where applicable; receipts will be issued upon request. Remote Imaging Group VAT Registration No. 594 7483 83. Channel Isles: divide by 1.175 to remove VAT content.

UK members, By Cheque or Postal Order.

Overseas members, Pay by Bank Draft (drawn on a UK London-based bank) or Eurocheque(s). (Payments to a Maximum of £100.00 in any one Eurocheque). No local currency please.

All cheques made payable to "REMOTE IMAGING GROUP".

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Please state type of card, Card No., Expiry Date.
All Credit Cards authorised before goods are despatched.
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RIG AT RALLIES

RIG will be at the following Rallies:

BARTG, Sandown	15 September
Leicester	18,19 October

SUBMISSION OF ITEMS FOR PUBLICATION AND COPY DEADLINES

Please send contributions, which should be original, to the Editor. Although typed and hand-written items are quite acceptable we would prefer longer pieces to be on a PC disk in one of the popular word-processing formats, ideally in Word Perfect. Drawings and diagrams may be submitted on disk, preferably in a Windows Meta File compatible format, but please send hard copy also. Diagrams and images must be in separate files and should not be embedded in documents. To reproduce well, satellite images must have a good range of tones. Contact the Editor for further information.

COPY DEADLINE FOR THE DECEMBER ISSUE: 25 OCTOBER 1996

RIG ON LINE

Bulletin board: Tel 01344 874140

World Wide Web: http://www.rig.org/index.html

Packet: G4TRE@GB7EIP - "WXSAT@GBR"

The BBS contains recent orbital elements, news likely to be of interest to members, the current satellite transmitting status, relevant software, some images and also members' 'For Sale' and 'Wanted' notices.

The WWW pages, which are still under development, contain images, status reports and information about remote sensing and RIG.

OTHER BULLETIN BOARDS

Timestep BBS:	Tel 01440 820002
Dartcom BBS:	Tel 01822 880249
Henry Neale BBS:	Tel 01945 440666

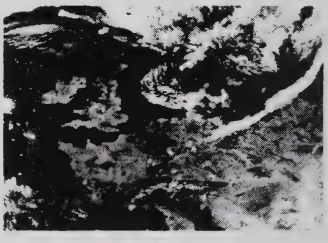
All the above bulletin boards use 8 bit, no parity, 1 stop bit.

LATE NEWS:

Japanese satellite ADEOS was successfully launched on 17 August. (See p 92)

TH2 Imaging

34 Princes Gardens
Margate
Kent CT9 3AR
Tel : 0843 - 223831
Fax : 0843 - 862212



TH2SAT PC Weather Satellite Processing System Version 2.2

- Instantaneous control of input levels from keyboard while receiving
- Input levels automatically saved
- Large range of *simple to operate* image processing commands
- Very simple image pseudo-colouring facilities (including infra red)
- High definition images obtained due to high 4800 hertz sampling rate
- Colour animation included as standard
- Fully working demonstration program available for £3.50

Price £100 + postage (RIG members)

A quarterly publication for hardware, software and applications of WEFAX, APT, VAS, HRPT and GOESTAP.

WeatherSat Ink

The Environmental Satellite Applications Journal

4821 Jessie Drive, Apex, NC 27502, USA

$18 US per year $23 (surface) or $33 (airmail) overseas, US funds

MasterCard / Visa OK

martelec communication systems

Antennas, Receivers, Downconverters, Software, Systems

MSR50 Virtual Satellite Receiver

A new and really exciting way to receive weather satellites. The MSR50 is a very high performance, synthesised receiver, totally controlled from your PC (IBM compatible or Amiga), providing unrivalled performance and features at a very modest price. See RIG43 article for details. The MSR50 is supplied complete with software (either PC or Amiga), and cable.

Special Introductory Price (until end Nov. '96) **£150.00**

MSC30 2-Channel Downconverter

Our policy of continual development ensures that the MSC30 Downconverter remains the finest you can own. Features include very low noise figure, high gain, buffered output for driving long cables, and good temperature stability. The MSC30 is housed in a professional sealed diecast box, and can be powered either via the coaxial feed, or by a conventional 3-wire system. High-quality N-type input, BNC output. Comes complete with 1.25m N-type/N-type cable, all connectors, and even silicon weather-proofing tape! **£205.00**

MSC50 Single-Channel Downconverter

Same high performance and outward appearance as the MSC30, but having only one oscillator, to reduce the cost for those wishing to receive Meteosat A1, GOES, & GMS (converts 1691MHz to 137.5MHz). Of course, MSR50 owners can still receive Meteosat A2 by tuning to 141MHz! **£180.00**

MSF30 1.7GHz Dipole Feed

A precision machined dipole feed suitable for Meteosat/GOES/GMS dishes with an f/d = 0.35 - 0.42. Features adjustable focus and polarization. N-type output socket. **£56.00**

MSH20 Professional 137MHz Crossed Dipole

A very rugged, well made turnstile. Comes with stainless-steel fastenings, and 20m terminated feed cable. **£59.50**

MSA20 137MHz Crossed Dipole

Standard turnstile antenna. Comes complete with 20m terminated coaxial feed. **£49.50**

MSK30 VHF Preamplifier

A low noise 137MHz preamplifier in sealed diecast box. This new design offers low noise (typ. 1dB) & gain = 12dB. Other gains available to special order (+6dB to +28dB) **£23.50**

Also available without case as MSK30M **£18.80**

NEW! Latest Version of Amigasat Released

V4.0 is now out! Many new software features, plus a new Series 2 interface with throughport facility for printer etc. Upgrades available to existing users (£50 - £35). Complete V4.0 System **£199.00**

Series 2 Interface only **£59.00**

Ordering Information

Prices shown include VAT for the U.K. and EU countries. For all non-UK countries additional carriage will be charged at cost.

Payment may be made by cheque, postal order, or Visa/Access/Mastercharge cards.

The Acorns,Wyck Lane, East Worldham, Alton, GU34 3AW, England. Tel / Fax 01420 82752

Timestep Offer to RIG Members
PROsat II Capture Card

PROsat II has become the most widely respected and definitive Weather Satellite Capture program used by RIG members. It will operate in most contemporary PC's (286, 386, 486 etc with SVGA) and uses one internal slot. All software features are selected with user-friendly mouse-operated pull-down menus. False colour can be added to good quality visible light images. Capable of receiving and decoding all known analogue weather satellites, PROsat II sets new standards in Software and Hardware design. Image processing, full colour animation and 3D are just some of the many features currently included. New features are constantly being added. Now technical support is directly from Timestep. Timestep Weather satellite systems are used and recommended by Arthur C. Clarke, author of "2001 : A Space Odyssey" and inventor of the communications satellite.

Other software comes and goes, sometime the flavour of the month, sometimes forgotten.
PROsat II just gets better and better ! When the new Okean 4 was switched on, it came as no surprise that PROsat II users merely clicked on OKEAN and achieved perfect results, first time.

Geostationary Satellites Meteosat, GOES and GMS are all geostationary satellites; they orbit at the same rate as the Earth and hence appear to be fixed in the sky. Images are therefore constantly available. The PROsat II system covers all known analogue geostationary satellites; images of the Earth's surface can be received as often as every 4 minutes. A small dish antenna is required together with some simple reliable hardware.

Polar Orbiting Satellites NOAA, Meteor, Okean and Feng Yun are polar orbiting satellites. They pass near to the poles about every 110 minutes. Each satellite passes over most countries twice a day at a different time each day. Their strength is such that a simple fixed antenna can be used. Direct readout of temperature along with latitude and longitude is an important feature of the software. Now land/sea and political boundaries can be superimposed on to the image and "nudged" if they are not quite perfectly aligned. All of the satellite data is stored; a full view of Infrared and Visible images are shown on the screen during reception.

Colour Animation Full screen, full colour animation is now standard. Up to 1,000 images can be automatically animated. The colour is realistic and computer processed (D2 section only) and even shows relative temperature by the shades of blue for the sea and green for the land. Clouds show up as white and shades of grey. Reception is completely automatic. Run the software and walk away; every time you pass, the computer will be showing the very latest sequence.

Geostationary Features
Images as often as every 4 minutes
Live display of incoming images in 64 grey scales
Auto schedule to save images
Pan and zoom to greater than pixel level
3D display
Median filter to remove country outlines
False colour with AutoSet
1,000 frame colour animation (option)
Transect between any two points
600 DPI, 300 DPI and dot matrix printing
Windows export
Annotation

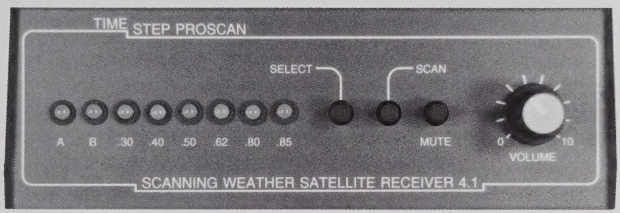
Polar Features
Reception of all polar satellites
Live display of incoming image in 64 grey scales
Auto schedule to save images
Saves the complete pass in full resolution
Temperature readout with no calibration
Latitude and Longitude gridding
Country and State outlining
Distance and Bearing between any two points
Your location shown on image
600 DPI, 300 DPI and dot matrix printing
Windows export
Annotation

Track II The tracking program used by most serious satellite watchers. This is not public domain and was written by Peter Arnold our Cambridge Graduate. Up to 6 satellites can be shown on screen all at the same time. Actual locations, their footprints and their rise and fall times are always shown. To our knowledge, no other program provides these features.

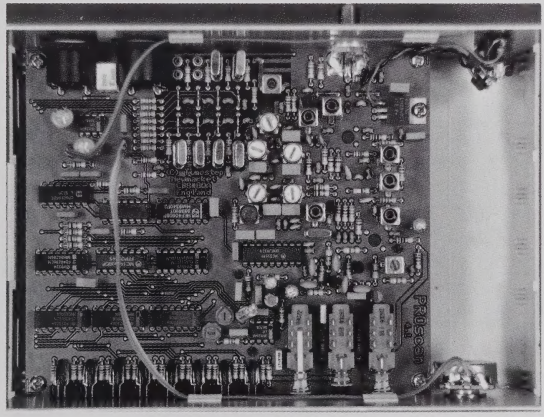
PROsat II Colour Animate, Track II, All NOAA/Soviets, Temperature calibration & PC Card

Timestep PO Box 2001 Newmarket CB8 8XB England
Tel. 01440 820040 Fax. 01440 820281

Timestep Offer to RIG Members
PROscan Polar Receiver



What do you want from a Scanning Weather Satellite Receiver ? a) Intelligent squelch that only responds to weather satellites and is quiet when no satellite is present b) To be able to read the frequency directly from the front panel when it stops on a satellite c) To be able to "lock out" unwanted satellites d) Resistant to pager interference up to the pager transmitter itself (where of course the field strength is low e) Resistant to pager interference at 1 to 2 miles where the field strength is at a maximum f) An unconditional 12 month money back guarantee g) Full technical support directly from Timestep **and** h) the ability to control the receiver frequency from the computer so that you are sure that **all** passes can be received in your absence.



The PROscan receiver uses a lot of filtering, 3 coils in the pre-amp (optional), 4 coils in the RF amp (total 7 coils at RF), 3 coils in the oscillator, 1 matching coil at first IF, 5 ceramic filters at first IF, 5 coils at second IF (total 11 IF filters) and a quadrature discriminator for linearity and high ultimate signal to noise. A preamplifier is not required for short cable runs but adds extra selectivity and makes up for feeder loss on longer runs.

Timestep PO Box 2001 Newmarket CB8 8XB England
Tel. 01440 820040 Fax. 01440 820281

Trade Talk

** Autumn news to **RIG Members** from Timestep **

Colour Catalogue, got yours yet, if not phone now !

PROsat for Windows Roger Ray was so excited with the increased resolution that he sent a complete description to Short Wave Magazine. Brian Dudman has ordered a second one, well he always had only the best !
The resolution, automatic colour, Meteosat and NOAA temperature calibration and the multi-tasking abilities are just so good. Animate the Whole World AND Europe AND get every frame in colour in 3 (or more) separate windows, zoom in for stunning detail and resolution. Colour animate and Track II included as standard.

WEFAX Many people only receive Meteosat, and why not, it sends images of the whole World, nearly 400 images a day, and you can animate automatically in full colour. You don't need a Down-Convertor or a Polar Receiver; just a dish, preamplifier and dedicated Meteosat receiver. No compatibility problems, no switching problems, no hassle, just lots of images !

HRPT Chris van Lint reports reception down to just 0.5 degree above the horizon from his flat in Hong Kong. Internet reports that the Timestep HRPT system is used by numerous customers with exceptional results. Remember you can make do without the Yaesu rotator and Autotrack, bits of string and pulleys ?

RIG Prices Timestep offer RIG members very preferential pricing. The price exists for the duration of the magazine, therefore pricing quoted in Issue Number 45 has now expired and the pricing in this issue will expire when RIG 47 is printed. If you are asking us for prices, you must identify yourself as a RIG member. If you do not mention RIG every time you will be quoted the standard list price.
All prices to RIG members are cash with order (no credit), we cannot supply items to anyone other than yourself. The prices are for cheques payable at a London Bank, MasterCard, Visa, Switch and bank transfer. We cannot accept Euro Cheques or official orders at these prices. Quotations are not needed, the prices below are correct. Remember PROsat II has now gone down in price and includes Track II and Colour Animate !

BBS Our BBS can be accessed by anyone with a modem. You do not need to be on Internet or have any complications. Plug the modem into your computer and that's it. No subscriptions no fees and no hassle. It is mostly updated every week and never more that 14 days old. Elements and news files and satellite status reports are easily down-loaded so that you can update your software and print out the news to read at your leisure.
We can handle virtually any standard right up to 28,800. The number to call is 01440 820002.

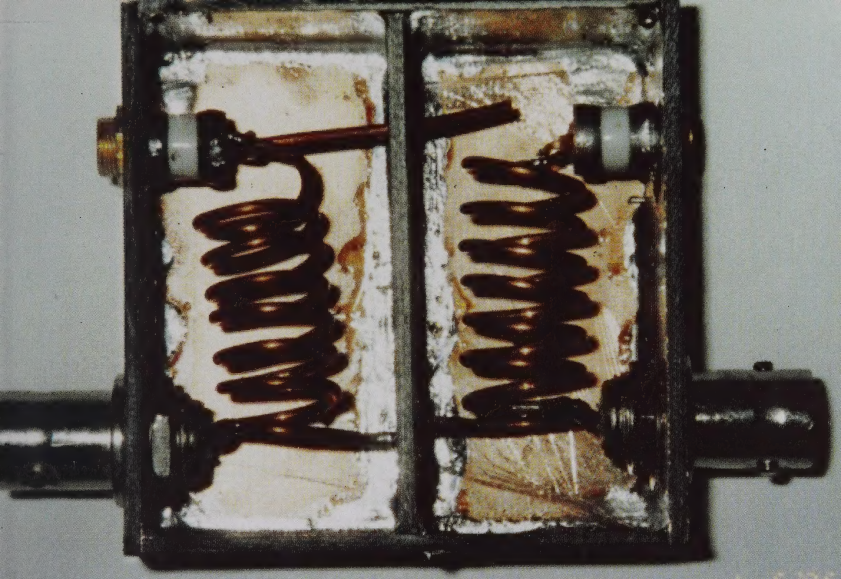
RIG Members prices

APT
PROscan receiver £225.00
VHF 137MHz preamplifier £25.00
Assembled crossed dipole antenna £45.00
40M antenna cable £36.00
APT-WEFAX Software
PROsat II card/software £99.00
PROsat II/PROscan cable £15.00
PROsat for Windows card/software £249.00
PROsat windows PROscan cable £29.50
WEFAX
90cm dish, feed & bracket £180.00
P-HEMT Preamp £95.00 (with RX only)
20M signal cable £18.00
Meteosat 2 channel receiver £275.00

HRPT
HRPT dish/feed £190.00
P-HEMT Preamplifier £95.00 (with RX only)
20M signal cable £18.00
Yaesu R5400 Az-El rotator £525.00
20M rotator cables (must be ordered with rotator) £95.00
Autotrack computer/dish controller £190.00
6 channel HRPT receiver £550.00
HRPT analogue card/software £250.00
PDUS
1.8M dish & feed £550.00
P-HEMT Preamplifier £95.00 (with RX only)
20M signal cable £18.00
2 Channel PDUS receiver £550.00
PDUS PC data card £250.00
PDUS Key card (key extra) £150.00

VAT included, carriage in the UK £6.00 per order, elsewhere £35.00 by Fed Ex/UPS.

Timestep PO Box 2001 Newmarket CB8 8XB
Tel. 01440 820040 Fax. 01440 820281



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